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POWER

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Do It Now

MOST of us have a routine of things that have to be done. The volume may vary, but the stream of time brings them to us and they must be cleaned up and sent along or obstructions and disorder, and perhaps worse, will result. We have other things, knitting work, that may be taken up as occasion offers or interest impels; things that are good to do, but that will not gum up the works or obstruct the orderly progress of our lives and jobs if neglected.

But once let an obstruction occur in the main stream, and you have set a trap for trouble.

If one of those things that ought to be kept going is not pushed on in its turn, but is allowed to grow and accumulate, it will become a center of annoyance and confusion that will interfere seriously with the even flow of the day's work.

And as the accumulation grows and the swirl around it becomes more forbidding, there is less and less disposition to tackle it and clean it up.

What would in the beginning have been an incident of the day's work has become a task requiring the special appropriation of considerable time.

Its performance, which in its turn would have been but an habitual gesture, is approached reluctantly with apprehension of the difficulties which neglect may have introduced.

It is probably safe to say that more waste and worry, more failure to make the grade, are occasioned by not doing promptly and regularly the things that one ought to do as a matter of course than by lack of opportunity or ability to do something especially notable.

F. R. Low

POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application

Specifications Do Not Assure Satisfactory Performance

THERE is a tendency on the part of some engineers to use specifications developed by others when purchasing equipment or material. This is all very well with certain items, but with many others is likely to lead to much trouble.

Consider refractories, for example. One plant, with definite conditions as to fuel used, ash characteristics and furnace conditions, may develop a satisfactory specification for firebrick, based on its experience. This success may lead a neighboring plant, with somewhat similar conditions, to adopt the specification. But the chances are that the refractory will not prove satisfactory to this second purchaser, there being just enough difference in the conditions to make necessary different properties.

With many materials it is therefore necessary to prepare a specification to suit the requirements of each plant. With others a standard specification will suit most plants. It is necessary that the engineer discriminate and prepare his own specifications where the needs of his installation demand it.

Less Waste in Power Transmission and Application

ROPE constructions used for elevator service vary widely with different manufacturers, as is evident from the article "Knowing the Ropes," in this issue. There is even a wide variation in construction among ropes used for a single class of service.

How the construction affects elevator-rope life has not been completely established. Certain designs and materials are known to be unsuitable. When these are eliminated, there still remains a sizable variety to select from. These have records of long life and also of miserable failures. Why the latter occur is often difficult to explain and probably will continue to be, until the factors affecting rope life can be better evaluated.

Some of these factors also have an influence on power consumption. If the tread diameters of traction-sheave grooves are not the same, some of the ropes must slip. This produces excessive wear on the ropes and increases power consumption. False stops by the operator cause unnecessary bending of the ropes, which reduces their useful life and increases the power used. Improperly adjusted brakes and other faults have similar results.

Rope renewals represent a major operating-cost item for high-speed electric elevators. It is, therefore, important that careful attention be given to features affecting their life. Conditions of traction-sheave grooves are not in general checked when ropes are renewed. It is only after one or two sets of ropes have given short life that the fault is looked for. At that time the extra expense for ropes, due to the fault, is many times the cost of correcting the defect, which should have been done before it caused trouble. Power and maintenance costs for elevators are kept at the minimum when the little defects are searched out and repaired before they develop into large ones.

Step-by-Step Modernization

LIKE the dog whose tail was chopped off in little pieces to save him pain, the power plant may be modernized one step at a time. Advocates of ruthless modernization in one fell swoop would have all the logic on their side if human and financial factors did not exist. These change the picture to such an extent that piecemeal modernization is all that is humanly possible in many plants.

A complete plan may be laid out on paper and justify itself by every possible analysis, but the financial plunge may require too great an act of faith on the part of those who must make the appropriations. Since they, personally, are generally incapable of checking the predictions of savings, they are naturally hesitant about proceeding on a large scale. Rather than argue the whole project to a standstill, it is often the part of wisdom for the power engineer to offer a step-by-step demonstration of his claims.

Instruments may well come first. With these alone, properly utilized, he can make a handsome saving. Moreover, he thereby acquires the necessary means of demonstrating this saving, and all that are to follow, to the management.

After instruments may come, step-by-step, boiler settings, stokers or pulverized-coal equipment, superheaters, bleeder turbines, electrically driven auxiliaries and other means of saving fuel and labor, and improving the quality of power services. The wise engineer can so plan the order of these installations and the time interval between them that he stands constantly justified by results in the eyes of the management.

This method of plant modernization is not the ultimate ideal because it unduly prolongs certain preventable losses, but it represents a necessary evolution in the human modernization of the men who manage.

In some of the great technical industries, where engineering thinking pervades the entire organization, wholesale changes are the rule. Such industries lead technically and their stocks generally head the list.

The Elder Statesmen

CHINA'S lack of progress has been attributed in part to the centuries-old practice of deferring to her elder statesmen.

Engineering societies have shown no disposition to follow China's footsteps in the matter of progress, yet it is not uncommon to see "elder engineers" summarily dismiss suggestions of merit brought out in discussions at meetings, simply because these suggestions do not happen to be in line with their individual experiences or in tune with the policies of their companies. It is fair to assume that these engineers are honest in their convictions, which, however, too often have become crystallized through practice and environment.

Leaders by virtue of accomplishment in certain lines and accustomed to having people defer to their views, these men are sometimes led to express opinions on matters of which they have very limited first-hand knowledge. Sometimes such views are not freely offered, but are given upon solicitation of the chairman, who feels that the success of the meeting depends on the extent to which these outstanding engineers participate.

The professional standing of a society is measured by the attainments of its members and it is a real privilege for the younger men to be associated with and listen to the counsel of these sages of the profession. The danger, of course, lies in unqualified acceptance of the opinions because of the very eminence of the men expressing them.

Why Not a One-Price Policy?

UNLIKE its biological counterpart, the evolution of machinery is unfolded daily before our eyes. Some who viewed Parson's first turbine with skeptical eyes have lived to behold units of nearly a quarter million kilowatt capacity. Truly, this development is evolution. Not so much can be said about the merchandising of power-plant equipment, for present-day methods are as primitive as in the day of James Watt. Barter, now as then, holds chief place, and a fixed-price policy is almost unknown.

Something could be said for a form of barter in the olden days when huntsmen came into the prehistoric hamlet to trade coon skins for a new stone ax. Coon skins, so the early ax manufacturers claimed, varied in quality—and likewise the axes, as the customer invariably pointed out. The transaction speedily took the form of a debate until, finally, somewhere and somehow, a sale was completed.

As long as man was dealing with coon skins and stone hatchets, bartering and variable prices were necessary, and even after money became the medium of exchange, fixed prices were not logical. In fact, as long as articles were produced by handicraft work with all its variations in results, a standardized price was impossible. The craftsman loved his work and placed such an undue value on the product that in self-defense the customer decried it. If sufficiently leather-lunged, he bought at bargain prices, but a timid soul was lost even before he entered the doorway. Take it all in all, the manufacturer obtained an average price that fairly represented the goods' worth.

With handicraft abolished and mass production the order of the day, goods are sufficiently identical in quality to make bartering unnecessary. It costs Ford a definite sum to build a car, and his interest lies in seeing that the car is taken away to make room for another. Who buys it is of little concern as long as a sale is made at a price that yields the correct profit; consequently, the fixed price is standard in the automobile industry, as in all others that lay claim to a degree of prosperity.

The manufacturer of power-plant equipment, save in exceptional instances, builds a standardized product. Then why should he not sell at a fixed price? Objections may be raised on the grounds that there is variation in the engineering services required. True enough, but, unfortunately, where the greatest time is consumed in making a sale the lowest prices are quoted, for the longer the time elapsing before the signing of a contract the greater are the chances of competition creeping in.

It is not difficult to obtain the average cost per sale to use as foundation for selling prices. If the power-plant executive knew that the quotations he received were the best obtainable from a particular manufacturer, sales would be effected more quickly and at lower cost.

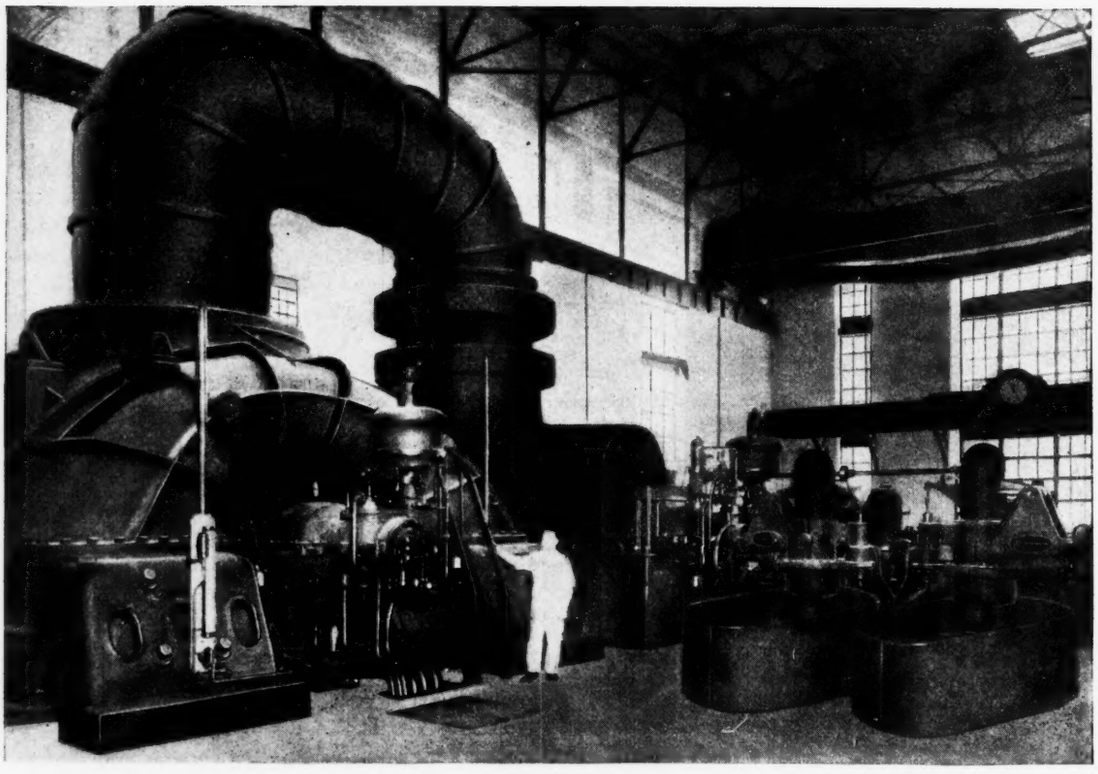
The Microscope in Power Plants

ONE usually thinks of the microscope as an instrument employed by medical men and scientists, but seldom as a tool of the power-plant operator. The latter, however, may find it well worth while to purchase a microscope, learn how to use it, and apply it to every-day power-plant problems.

To some this may seem a strange suggestion, but second thought will show that the microscope has a real place in every large power plant and even in some smaller ones. Condenser tubes are now purchased on specifications which define grain size, and microscopes or photomicrographs are used to check these sizes. Steels are examined under the microscope. With higher steam temperatures much closer attention will be given to the characteristics of steel for superheaters, piping, valves, turbine blading, etc. Also, steel parts can be accurately examined for indications of incipient failure from fatigue, caustic embrittlement or other reasons. The causes of boiler-tube failures, or burned water screens, may be found by such analysis.

Studies of pulverized coal and of its ash have already been made by the microscope, and improvements in coal preparation will undoubtedly result from these studies.

Space does not permit enumeration of the many other possible applications and uses of the microscope in the power plant. It is evident that the time is ripe for the operating engineer to become proficient in the use of this very effective tool.



No. 5 unit at the Hudson Avenue station of the Brooklyn Edison Company, Inc.

Design Features of BROOKLYN EDISON'S 110,000-kw. Turbine

By H. J. Hanzlik
Westinghouse Electric & Manufacturing Company

THE 110,000-kw. turbine-generator unit now in operation at the Hudson Avenue plant and known as Unit No. 5 was the largest generating unit in the world in operation when put in service. It is of the two-cylinder cross-compound type. The high-pressure element drives one main generator and is also coupled directly to one 350-kw. 250-volt exciter. The low-pressure element drives one main generator. Each of the two main generators for the Hudson Avenue Station of the Brooklyn Edison Company, Inc., has a rating of 68,750 kva., 80 per cent power factor, 55,000 kw., 13,800 volts, three-phase 60 cycles, and a speed of 1,800 r.p.m.

The turbine rating is based on operation with a 27½-in. vacuum. With a vacuum of 29 in. Hg. the turbine will develop 117,800 kw. when steam is extracted for feed-water heating, and 125,800 kw. under straight condensing operation.

The general construction features of the generators are shown in Fig. 1. The stator frame is of a new type in which the laminations are supported in a cast-iron structure, and the ventilation requirements are taken care of by means of an external superstructure. The machine was completely assembled at the factory, and the superstructure was then removed in order to meet railway and bridge clearances. The rotor is built up of hollow plates clamped between shaft-end forgings by the aid of four through-bolts.

One of the outstanding features in connection with these generators is that the ventilation requirements are taken care of by means of internal fans. The design of the fan is somewhat novel in that aluminum blades are used and the blades are curved so as to reduce stresses due to bending. Each of these generators, which have a multiple system of ventilation, requires approximately 110,000 cu.ft. of air per minute. The pressure required to circulate the air through the generator air ducts and air cooler is approximately fifteen inches of water.

The total weight of the complete turbine-generator unit is 1,060 tons—650 tons for the turbines and 400 tons for the generators. Steam is supplied to the high-pres-

sure turbine element through one large steam inlet piece having two 22-in. outlets, each connected to a 22-in. steam strainer, throttle valve and a three-valve steam chest, and thence through a number of flexible pipe loops below the floor to the high-pressure cylinder. Steam at 400 lb. pressure and 710 deg. F. total temperature is supplied to the turbine and discharged from it to the condenser at a pressure of one inch, mercury absolute. The turbine is designed for steam extraction from two stages for heating the feed water in two surface heaters from 77 to 272 deg. F. at maximum load.

The high-pressure element is of the single-flow type, having a two-row impulse wheel together with nineteen pairs of reaction blading. The low-pressure element is of the double-flow reaction, multi-exhaust design and has ten pairs of reaction blades on each side of the steam inlet. The last two pairs in this turbine include blading of the multi-exhaust design. All blades are of *polished* stainless steel.

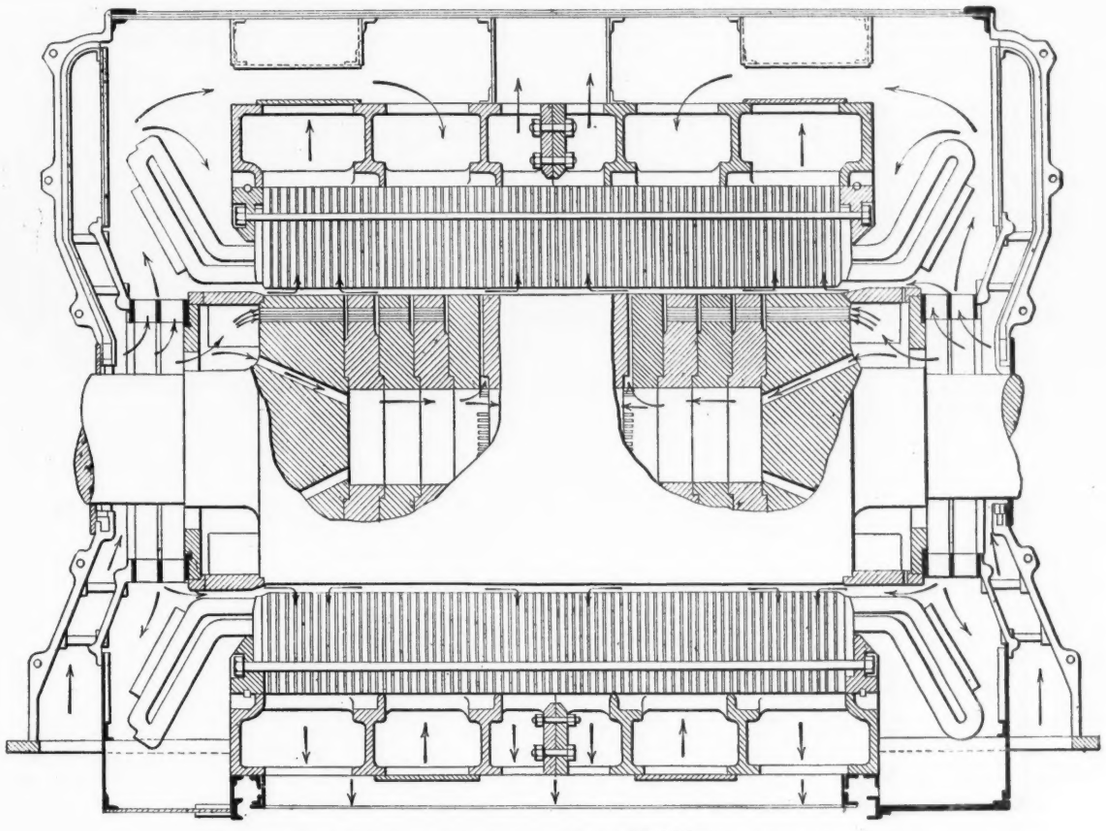


Fig. 1—Section through one of the 55,000-kw. generators

The high-pressure cylinder is made in two parts. The thrust end, carrying the nozzle chamber and the dummy ring, is made of cast steel. The coupling end of the cylinder does not contain any blades and is made of cast iron.

The primary, secondary, tertiary and quaternary nozzle chambers are in the base and cover of the thrust end of the cylinder and have a series of circumferential feet resting on bored supports in the cylinder. These chambers are located in the longitudinal direction by circumferential tongues and grooves and each is held in correct radial position by a radial key and clamp arranged at the inlet of the nozzle chamber, permitting free expansion of the nozzle chamber from this key point. The inlet openings to the nozzle chambers are short-flanged nozzles with the machined faces in the same plane as the corresponding flanged faces on the outer cylinder wall. A thin steel diaphragm is bolted to the main cylinder structure and to the nozzle chamber, to seal against steam leakage from the impulse chamber and at the same time to take care of the expansion of the nozzle chamber. The two quinary valves admit live steam into the impulse chamber when maximum load is carried.

In the region of high pressure and temperature the halves of the cylinder are held together by chrome-nickel steel studs. These studs have their axes drilled with stepped measuring holes that permit a heating element to be inserted to give the studs proper stretch and to allow entry of a micrometer for measuring the predetermined stretch of the stud.

Combined labyrinth and water glands are provided on each end of the cylinder. Each water gland consists of runner vane segments mounted on a stainless steel sleeve. The sleeve is provided with a vertical face flange, bolted to the spindle, thus preventing air leaks along the spindle. Water passes through two annular channels at the outer periphery of the runner and flows from the inside out. A sufficient quantity of water is circulated through these glands to reduce evaporation to a minimum.

The spindle is a single forging with a bolted spindle extension at the thrust end. This extension carries the thrust collar, main centrifugal-pump impeller, governor worm gear and automatic stop. The spindle has a two-step radial-contact dummy of standard design. The steam that leaks from between the two dummies is carried to a point between the first and second reaction elements through a number of holes in the spindle body. Steam passing through these passages keeps the spindle uniformly heated, and at the same time it returns to a

point where it cannot mix with wet bleeder steam, but has to do useful work.

A thorough examination of the center core of the shaft forging was made with a special telescope instrument that was inserted through a central inspection hole bored from end to end of the spindle. Provision is made for attaching spindle truth indicators between the oil rings and glands to indicate the amount the spindle goes out of true when heated or cooled. To keep the spindle straight during shutdown periods, air nozzles are provided in the cylinders, by means of which air may be circulated inside of the cylinder and around the spindle body to keep the temperature uniform. There is also provided a motor-operated turning gear which rotates the spindle at slow speed during shutdown periods to insure uniform cooling of the rotating element. In this manner it is possible to reduce greatly the time required to bring the turbine up to speed when starting.

Steam leaves the high-pressure turbine through an upward exhaust and an overhead receiver pipe entering the low-pressure cylinder through the upper end of the cylinder cover. The receiver pipe is made of welded steel plate and is reinforced by beam sections bent around the circumference at several places to resist collapsing from atmospheric pressure. The maximum temperature in the pipe is normally about 326 deg. F., and the lateral expansion is taken care of by a diaphragm expansion joint. The expansion joint is held by two heavy links placed diametrically opposite and so located as to permit a movement parallel to the axis of the pipe. These links withstand the collapsing stress at light loads and the bursting forces at full load. Water sealing is not employed.

The low-pressure cylinder is split into three main parts —thrust end, center and coupling end. These three parts inclose a loose blade ring which carries all the stationary blades except the last row at each end. These last stationary-blade rows are supported by the cylinder ends. The outer cylinder parts inclose the vacuum side of the turbine and are, therefore, cool. To this cool outer structure are attached the cylinder feet, which rest on adjustable wedge blocks.

The cylinder blade ring is supported by the outer cylinder from a point close to the horizontal joint, to maintain concentric alignment of the blades when the parts are subjected to varying temperatures. Vertical and longitudinal position of the blade ring is obtained by adjustable liners. Expansion of the blade ring at the steam inlet end and its expansion at the bleeder outlet is taken care of by copper diaphragm expansion joints. The blade ring has two annular bleeder chambers that lead wet steam downward through a 26-in. bleeder pipe in the low-pressure heater system. This 26-in. pipe is inside of the condenser shell and has a copper expansion joint. The exhaust chamber of the cylinder is provided with stream-line guide ribs that lead the exhaust steam into the condenser, avoiding sharp turns in order to obtain the most efficient steam flow. The exhaust end of the cylinder is bolted to the coupling end pedestal, forming an anchor for the low-pressure turbine. The thrust-end pedestal is bolted directly to the cylinder base.

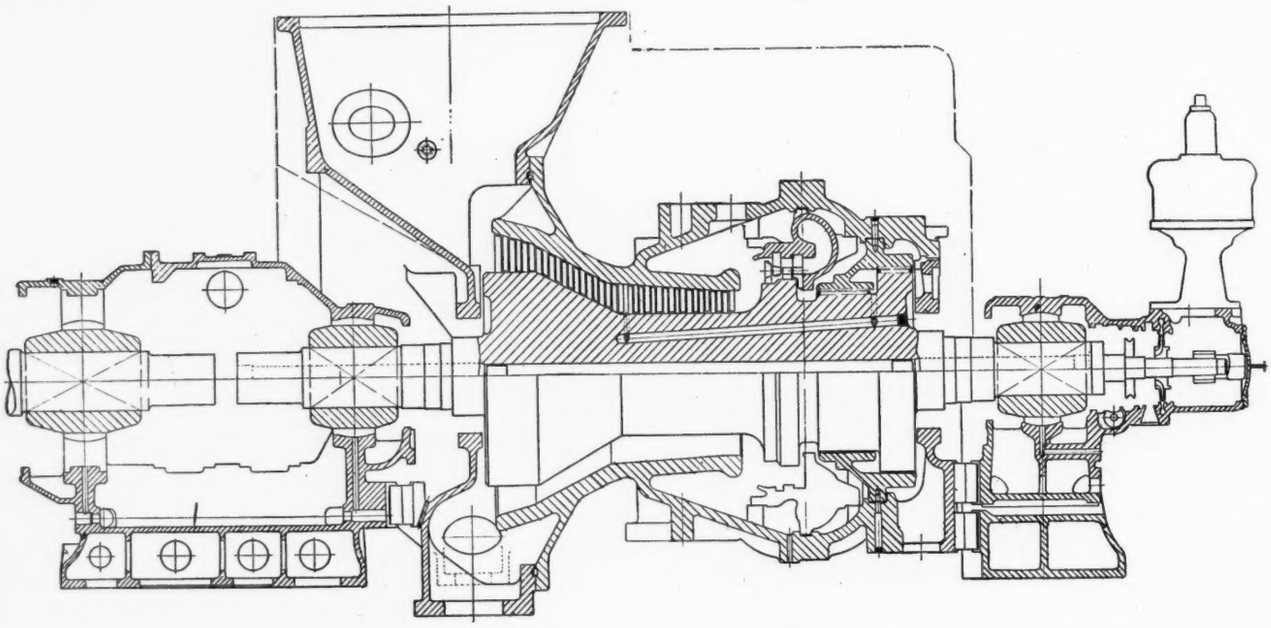


Fig. 2—Section through the high-pressure cylinder

The spindle of this double-flow turbine is made in two pieces about equal in size, with a shaft extension at the thrust side. Each forging has an inspection hole bored from end to end. These holes are covered at the inside end by flanges, to prevent undue heating of the journals. The size of the spindle is such that it can be shipped completely assembled and bladed. This is of considerable advantage, as it eliminates the necessity of taking the spindle apart for shipment and subsequent reassembly in the field. The bladed spindle can, therefore, be installed in the condition it is in after it has been seasoned in the heater box. Two rows of tapped holes are provided on each end of the spindle for shop and field balancing. All the blades are made of polished stainless steel. The last three rows on each end of the spindle are of the new side-entry type that permits lighter design of the spindle and facilitates removal of individual blades. The side entry blades have a curved root of serrated section. The curvature of the root conforms with the curvature of the blade body, permitting a good distribution of centrifugal stresses over the blade fastening.

The lower part of the blade root is rolled over the spindle rim at the ends to prevent any tendency of the

blades to slip out endwise. All the blades are provided with standard lashing to reduce vibration. Long blades are tapered toward the outer tip to reduce centrifugal stresses, and the cross-sections are warped to secure the best possible steam flow. The last rows of blades are of the multi-exhaust type that deflect part of the steam in the next to the last blade row into the exhaust chamber, permitting the remainder of the steam to undergo further expansion in the last blade row. In this manner a large exhaust annulus is obtained, for the given blade height and rotor diameter.

The governing system consists of two standard flyball governors, one driven from the high-pressure and one driven from the low-pressure turbine. The high-pressure governor operates all six valves in proper sequence with a speed regulation of 4 per cent for all valves. The speed-changer spring provides an adjustment of plus or minus 5 per cent of no-load speed. The flyball governor on the low-pressure turbine acts as an overspeed governor. It is set to close the main governing valves at 7 to 8 per cent overspeed. Besides these flyball governors each spindle is protected by a standard automatic stop governor. If either of the spindles overspeeds 10 to 11 per cent, its autostop governor will act to close all six governing valves and the two throttle valves.

The sleeve of the high-pressure governor is connected to an oil relay which actuates a rockshaft operating piston. This piston operates a rockshaft running parallel to the axis of the high-pressure spindle from the governor to the steam chests. This rockshaft has two levers, each actuating through a connecting rod another rockshaft that is perpendicular to the axis of the spindle and is parallel with the axis of the steam chest. On each of these latter rockshafts there are three cams, each engaging an oil relay. Each relay controls an operating piston, one for each main governing valve. The six governing valves are arranged in two parallel-flow steam chests and are in parallel with each other. The valves are of the standard double-ported poppet and balanced type and are seated in forged steel cages. These cages have at their lower end several V-shaped ports to improve regulation at light loads. Steam is brought to the two steam chests through two 22-in. basket-type strainers and two 22-in. throttle valves. From the steam chest the steam passes through a number of flexible steam pipes below the floor into the high-pressure cylinder.

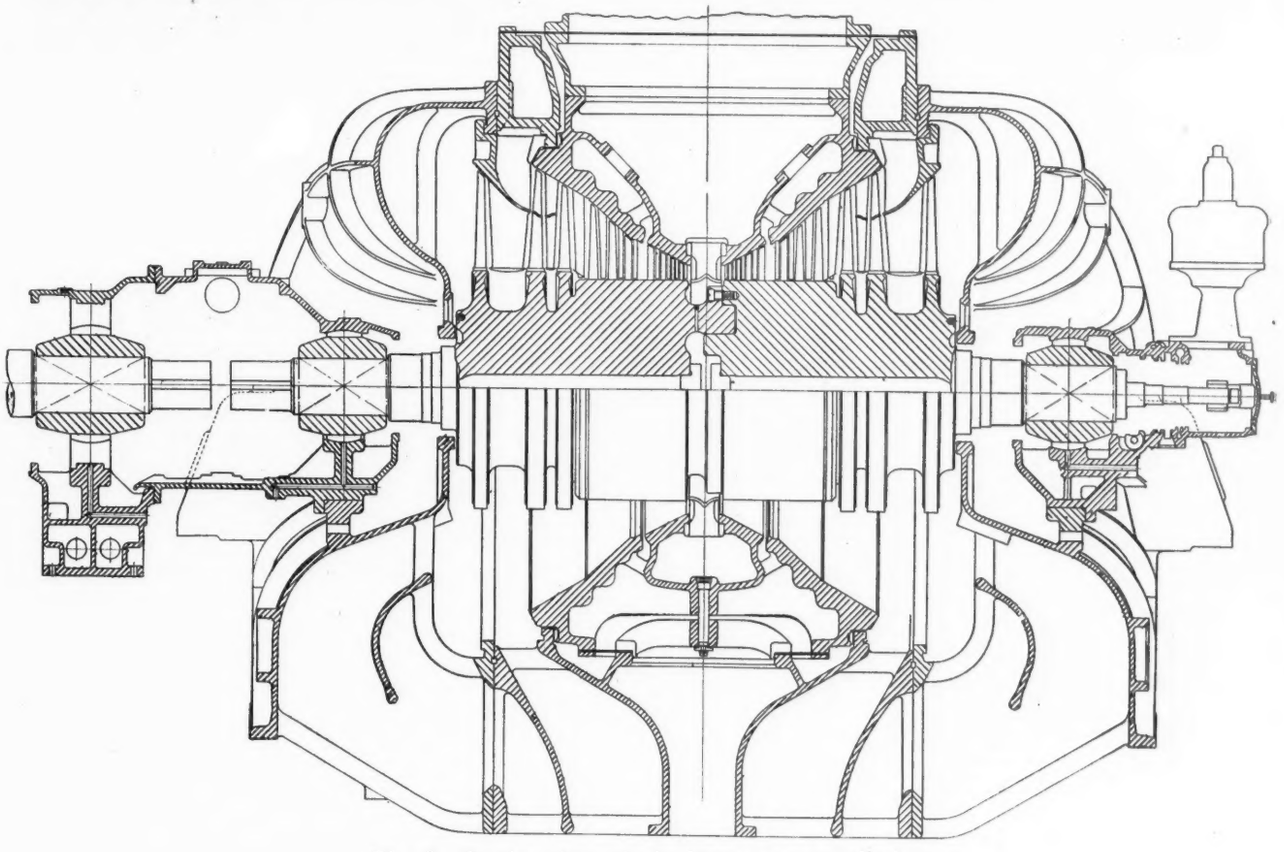
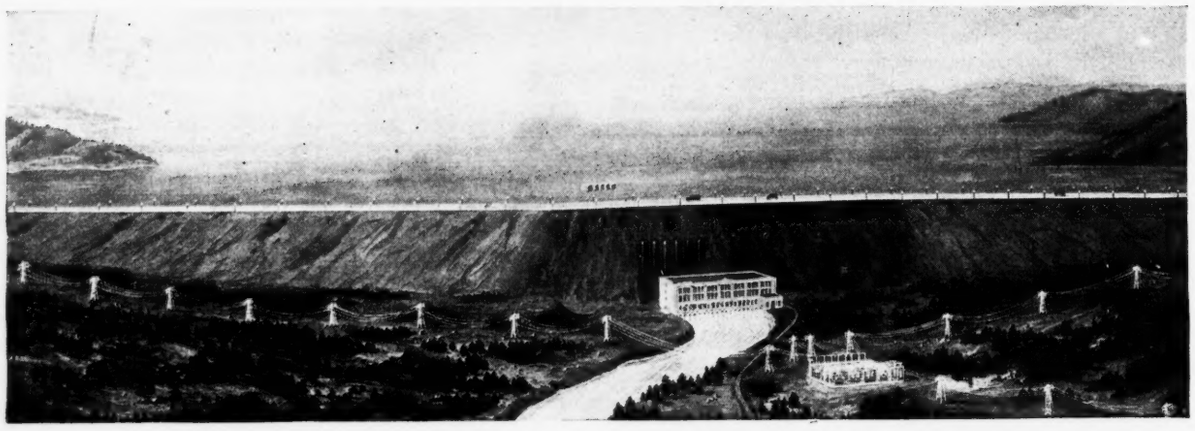


Fig. 3—Section through the low-pressure cylinder

The throttle valves are of the standard type. They are unbalanced when closed, by reason of the steam-line pressure having access to the chamber above the steam balance piston. When the valve is opened, the steam pilot valve opens, first releasing steam from above the piston, permitting the valve to become nearly balanced. The stem of the throttle valve is connected on the top to a powerful closing spring that is released for action by an oil-operated tripping mechanism actuated by the autostop governor. This spring closes the valve, the closing being retarded at the lower end of its stroke by an oil dashpot. Resetting of the throttle is accomplished by means of linkage and a geared handwheel. The throttle-valve body is of the stream-line flow type that will pass the steam with little drop in pressure.

The machine was designed to give an exceptionally flat steam-rate performance curve. From a load of 70,000 to 90,000 kw. the curve is almost a horizontal straight line. From 90,000 kw. to full load the steam rate increases only 0.2 lb. per kw.-hr. At the other end of the curve between 70,000 and 45,000 kw., the steam rate increases only 0.45 lb. per kilowatt-hour.



Power house and dam as it will appear when completed. Surge tanks on the penstocks located back of the station

SALUDA

A 300,000-Hp. Hydro Development

in South Carolina, will have one of the largest earth dams and storage reservoirs in the world. Station planned for six 50,000-hp. units, four to be installed in the initial plant

NEAR Columbia, S. C., on the Saluda River, the Lexington Water Power Company is actively engaged constructing one of the largest hydro-electric developments in the Southeast. The project's size, its engineering features, the storage-reservoir capacity and its effects on the plant's operation give this development an outstanding significance.

An earth dam nearly a mile and a half long is being built across the river. This dam is approximately one-quarter mile wide at its base and will contain 11,000,000 cu.yd. of earth fill. Its crest, with a highway eighteen feet wide, will be 208 ft. above the average rock-bottom height in the river.

This dam will form one of the world's largest artificial storage reservoirs. With a shore line 520 miles long, the reservoir will have a maximum length of 41 miles and be fourteen miles wide. Its capacity, 93 billion cubic feet, is exceeded by only two other reservoirs: The Gruin, on the St. Maurice River, Quebec, 160 billion cubic feet; and the Elephant Butte, New Mexico, 115 billion cubic feet.

In general, hydro-electric developments in the South have relatively small storage, consequently their power output fluctuates with stream flow. This condition makes necessary, in many localities, supplementing water power with steam plants. Saluda has sufficient storage capacity to make a stand-by steam plant unnecessary.

Another benefit resulting from the reservoir will be a more uniform flow in the Saluda River below the dam. The river's flow varies from 142 to 100,000 sec.-ft. The construction of the dam will create an average flow of about 12,000 sec.-ft., with the maximum reduced to about 60,000.

To fill the reservoir will require about ten months of average stream flow. As the construction of the dam progresses, the reservoir will be filled gradually, so that by the time the work is completed the reservoir will be practically full.

Four steel penstocks, 16 ft. in diameter, and a 48-ft. concrete-arch conduit rest on rock foundation in the river's bottom and pass through the base of the dam. During construction the concrete conduit will carry the river's flow through the dam. When the plant is completed to its ultimate capacity, the conduit will accommodate two additional penstocks. Four concrete towers, 30 ft. in diameter, in the reservoir form the penstock intakes. A concrete tower 60 ft. in diameter will contain the control works at the entrance to the concrete-arch conduit. Gates will be provided in the towers to shut off the water from the penstocks and conduit.

Near the dam's downstream toe the power house will be built. A surge tank 206 ft. high will be connected to the lower end of each penstock. In each penstock near the scroll case will be a pivot valve to cut the water out of the wheels when they are shut down.

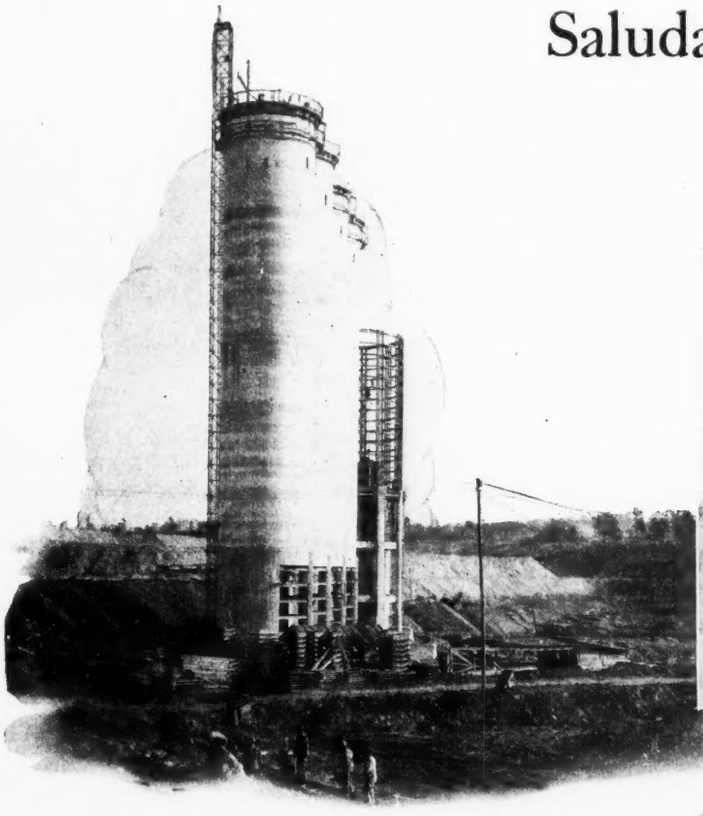
In the initial development there will be four units, each rated at 49,000 hp. under 165 ft. head. Their capacity will vary with the water level in the reservoir. The largest part of each unit will be the generator's rotor, which will weigh 410,000 pounds.

Clearing the site was started in April, 1927, and construction was begun in September of that year. It is expected that the development will be completed in the fall of 1930.

The general contract for the project was given to the construction division of W. S. Barstow & Company, Inc., New York, which contracted with the Arundel Corporation, Baltimore, for the construction of the conduits and dam. Murray & Flood, New York, are the engineers and A. S. Crane, New York, consulting engineer.

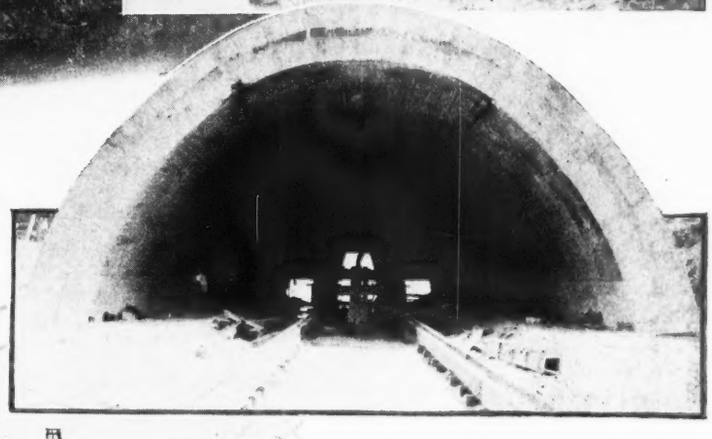
Some of the Work Now in Progress on

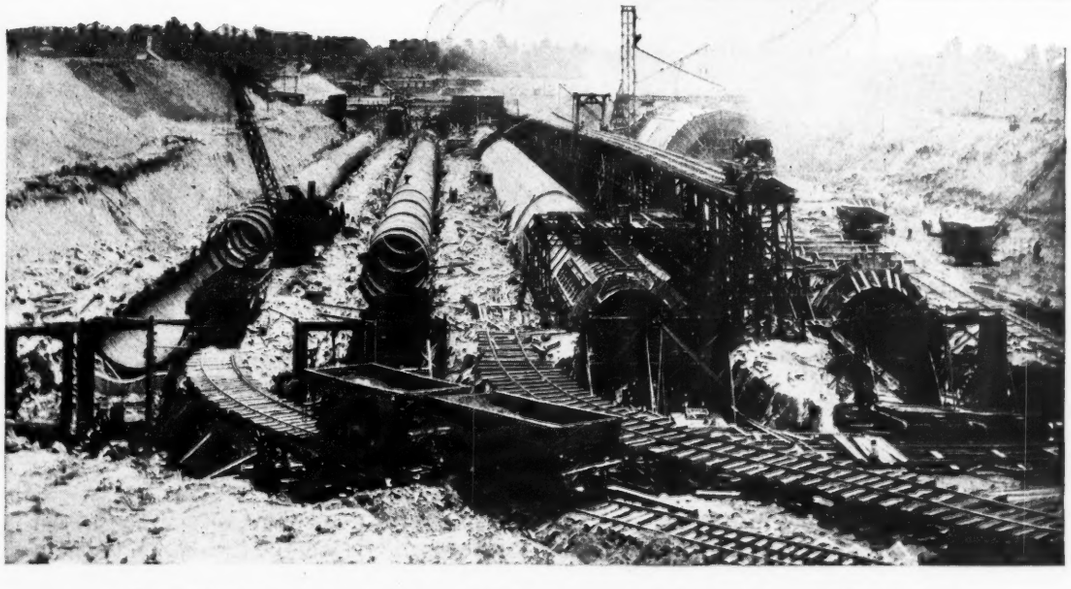
Saluda Development



Above—Four reinforced-concrete intake towers 30 ft. in diameter by 223 ft. high, will contain the control works for the penstocks. A 60-ft. concrete tower will contain the control works for the 48-ft. concrete arch conduit shown on the right

Below—One of four sixteen-foot steel penstocks that pass under the dam





Four 16-ft. steel penstocks and 48-ft. concrete arch conduit are laid in the solid rock bottom foundation for the dam

KNOWING THE ROPES

Warrington or Seale Construction—Regular or Lang Lay—Preformed Types—Round or Flattened Strand—Non-Rotating Combinations

. . . . *Which for Elevator Service?*

BY F. A. ANNETT
Associate Editor, "Power"

WIRE rope is an important part of electric elevator equipment. It connects the car and counterweights with the hoisting machine and the overspeed governor to the car safety devices. Therefore the car's operation and the safety of the passengers depend upon wire rope. For this reason those responsible for elevator operation should be familiar with wire-rope constructions and the factors affecting its service and safety.

Wire rope is made in a great variety of forms and of many materials. Although generally made of some grade of iron or steel, Monel metal, bronze and other metals are used for special conditions. For example, Monel-metal rope is a non-corrosive type, suited for wet places, as in meat-packing houses or where chemical fumes or salt in the atmosphere would destroy iron or steel rope.

The material used in so-called iron rope is a very mild steel, containing about 0.1 per cent carbon. It is comparatively soft, ductile and of low tensile strength. Wire of this material for rope construction has a tensile strength of about 85,000 lb. per square inch.

What is known as traction steel, a form of toughened mild steel containing about 0.35 per cent carbon, is used extensively for traction-type elevator ropes. This material has a tensile strength in the wire of about 150,000 to 170,000 lb. per sq.in. Cast steel, the first of the so-called higher-carbon steels and frequently called crucible steel, is another common material used in wire-rope construction. It is one of the most ductile of the high-carbon steels, having a tensile strength in the wire of from 170,000 to 220,000 lb. per sq.in. Three other steels, designated as mild-plow, plow and improved-plow are in common use for wire-rope construction. They have a tensile strength in the wire of about 220,000 to 280,000 lb. per sq.in. These and others, appearing under various trade names, are mostly some form of open-hearth steel.

The steel used in wire rope is carefully checked and analyzed at the various stages of the manufacturing process from the furnace until it forms the complete rope. This is done to make sure that the rope is of the proper quality. The process followed in making wire rope is to cast the steel into ingots, which are rolled into billets. These are rolled into rods 0.2 to about $\frac{1}{2}$ in. diameter. From here, all reductions are by cold drawing through a steel die. At different stages in the drawing process the steel is heat-treated to give the wire the desired properties.

Of the various materials previously mentioned for wire rope construction, iron and mild steel are about the only ones used for elevator ropes. Mild-steel ropes frequently appear under the trade name of traction steel or other designations.

The ideal rope would have great strength and stand a large amount of bending without fatigue and breaking of the individual wires. Under the present state of the steel-making art it is impossible to obtain the maximum of these two qualities in the same rope. The higher the strength given to the wire, the harder and more brittle it is. Although plow-quality steels have great strength, they lack the necessary ductility for elevator service. These higher-carbon steels have a wide range of use in mining duty, logging lines, excavating machinery, dredges, heavy cranes and similar applications.

After the wire has been drawn to size and heat-treated to give it the desired qualities, it is ready to be formed into rope. Rope making consists of twisting a given number of wires into a strand and laying a number of these strands about a hemp center. In some cases, for use on dead loads, disk conveyors and hot-metal cranes, a wire center is used. Tiller rope and mooring line have strands made with hemp centers. In general the strands are laid around a central wire, although in some constructions they have centers of special forms.

This article is the first of three on elevator ropes and deals with such fundamental information as the materials used for wire rope, size and arrangement of wires in the strands, strand lays used in rope construction, etc., knowledge essential to intelligently discussing the selection of rope for a given service. The second article will treat of rope selection for elevator service and the third will cover installation and care of rope.

The combinations of wires and their size in a strand and the number of strands in a rope are almost unlimited. There are on the market about 80 different constructions varying from three to 91 wires in a strand and from three to 19 strands in the completed rope. Only a few of these constructions are in general use for elevator service.

Hoisting Rope Constructions

A common hoisting-rope construction is one that has six strands of nineteen wires per strand, known as the 6x19 construction, Fig. 1. Each strand has a central wire about which is placed a layer of six wires. Outside the six-wire layer is another of twelve wires, both layers being twisted in the same direction. The rope is formed by laying six of these strands about a hemp center, as in the figure.

Another common construction has six strands of 37 wires each. Where the wires in the strands are all approximately the same size, the construction is the same as for the nineteen-wire strand, but with a third layer of eighteen wires. This is the highest number of wires per strand used for elevator hoisting ropes.

For certain purposes where a very flexible rope is required, 61 and 91 wires per strand have been used. The 61-wire strand is obtained by adding a layer of 24 wires over a 37-wire construction. Adding a 30-wire layer over the 61-wire construction produces the 91-wire strand. These various constructions are shown in Fig. 2. The greater the number of wires per strand for a given size rope, the smaller the individual wires will be in cross-section.

Except for hawsers, mooring lines and guys, few wire

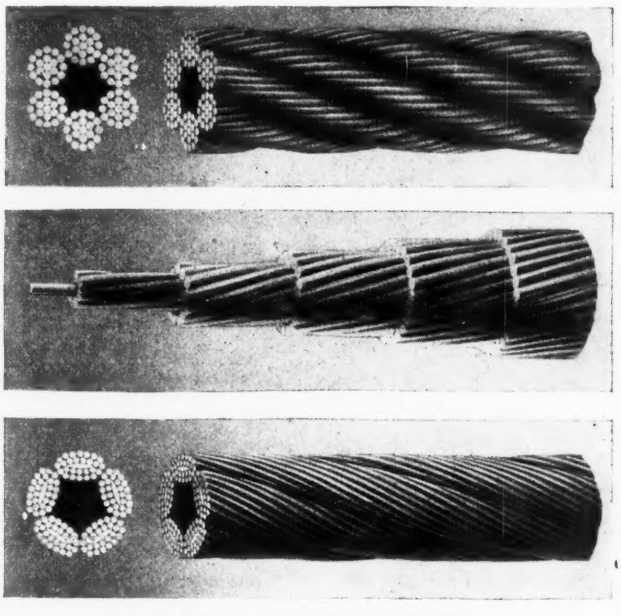


Fig. 1 (Top)—Regular 6x19 wire-rope construction
Fig. 2 (Center)—Strand construction, ranging from seven to 91 wires
Fig. 3 (Bottom)—Flattened-strand rope construction with elliptical-ribbon center

ropes are made with all wires the same size. Even when the wires may appear to be the same size, as in the 6x19 regular constructions, the inner ones are slightly larger than the outside ones. This difference in size is necessary in a rope of this kind, to obtain a construction that will stand bending and retain the original arrangement of the wires in the strands.

Another rope used for elevator service has eight strands of nineteen wires each. Although this construction is more flexible than 6x19, it is not so strong for equal diameter. To get eight strands within the same

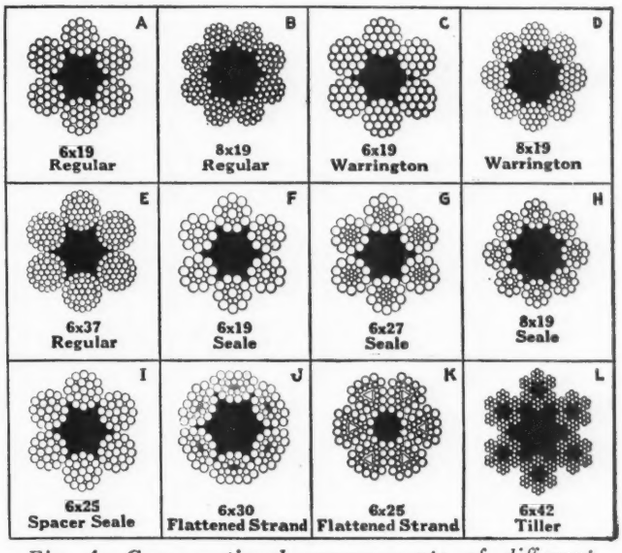


Fig. 4—Cross-sectional arrangements of different types of wire rope

diameter, each strand must have a smaller diameter than when six are used. The strands in the 8x19 construction being smaller than for the 6x19, the hemp center is large, consequently the eight-strand rope has less metal and strength than the six-strand construction. For example, the breaking strength of a $\frac{5}{8}$-in. 6x19 cast-steel rope is about 25,000 lb., whereas a $\frac{5}{8}$-in. 8x19 rope of the same quality will break at about 22,000 pounds.

Fig. 4 shows the cross-sections of various rope constructions used in elevator service. *A* and *B* are the regular 6x19 and 8x19 types respectively. All wires in either of these are approximately the same size. Constructions *C* and *D* have three sizes of wire. The seven inside wires are approximately the same diameter and are surrounded by twelve that are alternate large and small, a construction known as "Warrington." Experience has shown *C* and *D* to be satisfactory constructions, and they are used extensively.

Where bending stresses are severe, the 6x37 construction, shown at *E*, is sometimes used. Each strand is made of 37 wires of approximately the same size and six strands are laid about a hemp center to form a rope. Since the wires are small, the rope is not suited to conditions where wear is an important factor in its life.

Another construction, used for elevator hoisting ropes, is known as Seale; three different combinations, *F*, *G* and *H*, being shown in Fig. 4. The 6x19 Seale construction has one large center wire surrounded by nine small ones, around which are nine large wires. This construction will, for many conditions, stand more wear than constructions *A* and *C*. The rope is somewhat stiffer than the other constructions and is not suited for use on small sheaves or where it would be subjected to short reverse bends.

The 6x27 Seale construction *G*, Fig. 4, has seven small wires in the center of each strand, with ten small wires

and ten larger ones laid over the seven center wires. This is a more flexible construction than obtained with the 6x19 Seale.

At *H* is shown an 8x19 Seale construction. The strands in this rope are made the same as for the 6x19, but with smaller wires. The 8x19 construction is more flexible than those shown at *F* and *G*, but it has less metallic cross-sectional area and tensile strength. The

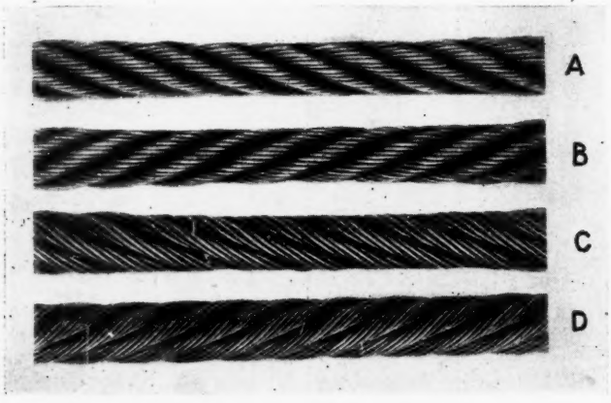


Fig. 5—Rope lays in general use
A—regular-lay, right-lay; *B*—regular-lay, left-lay; *C*—Lang-lay, right-lay; *D*—Lang-lay, left-lay.

Seale construction is such that the crowns of the inside wires fit into the valleys between the outside wires. This allows a close construction of the strands, resulting in an increased metallic cross-sectional area and strength. The 8x19 rope has superior bending qualities compared to those of the 6x19 construction. Where ropes are subjected to reverse bends, the 8x19 is, in many cases, preferable to 6x19 construction.

Another Seale construction is known as spacer Seale, a 6x25 section being shown in Fig. 4 *I*. This construction has six wires twisted around a center wire, all wires being approximately the same size. Six small spacer wires are placed in the valleys between the six large wires laid around the center. Over these are laid twelve wires of approximately the same size as the center ones. The six small spacer wires act as keys to maintain a fixed relation between the outside and inside wires in the strand.

To obtain a rope with large wearing surface, a flattened strand construction is sometimes used. Two types of these are shown in Figs. 4 *J* and *K*. The center of the strand, construction *J*, is made of nine small wires arranged to form an ellipse. About this center are laid nine larger wires over which is placed a layer of twelve wires. These wires are slightly larger in diameter than used in regular 6x19 rope construction. This rope has a larger wearing surface than ordinary types and is more flexible than the regular 6x19 construction.

Another flattened-strand construction, somewhat similar to *J*, has an elliptical ribbon center, Fig. 3, but is not as flexible.

In the construction Fig. 4 *K* the strands are made of a triangular center wire about which are twisted twelve small wires. Over these are laid twelve larger wires. This gives a strand having a form approximating an equilateral triangle. Six of these strands are laid about the usual hemp center to form a rope. These flattened-strand constructions have about 50 per cent more wearing surface than round-strand rope and *K* is stronger than round-strand types of the same materials.

Where a very flexible type is required, such as for the operating rope on hand-operated cars, what is known as tiller rope is used, Fig. 4 *L*. This has six strands, each constructed like a 6x7 hemp-center rope. These strands are laid about a hemp center, making a very flexible arrangement, but its strength is only about one-half that of the other constructions.

Numbers and sizes of wires, their arrangement in the strands and the number of strands tell only a part of the story of a rope's construction. The way the strands are laid to form the rope must also be known. There are two lays, regular and Lang. These lays may be either left or right. A right-lay regular-lay rope is shown in Fig. 5 *A*. In this construction the strands are laid to give the appearance of a long-pitch right-hand thread on a bolt. A nut threaded to fit the pitch of the lay could be threaded onto the rope by turning it in a clockwise, or right-hand, direction. What has been said regarding a right-lay regular-lay rope applies to a left-lay regular-lay, Fig. 5 *B*, except everything is left-handed. Lang-lay rope can be obtained in either right and left lay, as shown in Figs. 5 *C* and *D*.

Regular-lay rope has the strands twisted in an opposite direction to the rope lay. For example, in the right regular-lay rope, Fig. 5 *A*, the strands are twisted in a clockwise direction, but the rope has a counterclockwise twist. In a Lang lay the strand and rope twist are the same as *C* and *D*, Fig. 5. A right Lang lay *C* has the strands and the rope twisted in a counterclockwise direction. In a regular-lay rope the outside wires on the

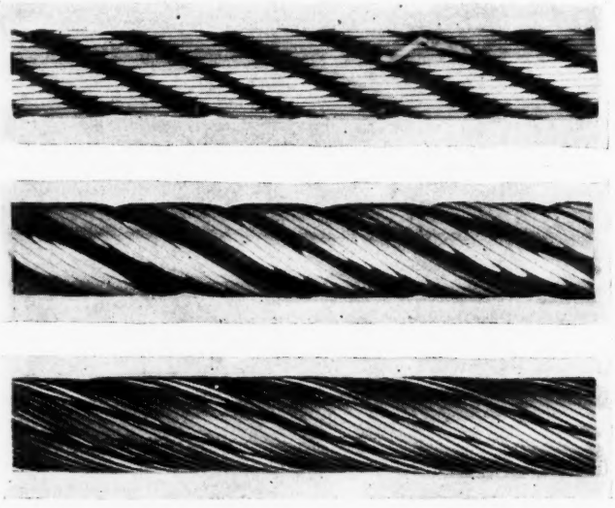


Fig. 6 (Top)—Partly worn regular-lay round-strand rope
Fig. 7 (Center)—Partly worn Lang-lay round-strand rope
Fig. 8 (Bottom)—Partly worn flattened-strand rope

strands run almost parallel with the axis of the rope, but in a Lang lay these wires tend to follow around the rope with the strand. These characteristics are clearly seen by comparing *A* and *B* with *C* and *D*, Fig. 5.

Lang-lay rope is more difficult to handle than regular lay, as it has a greater tendency to unstrand. It is also more easily kinked and bird-caged than regular-lay rope. For these reasons Lang-lay rope has not been used extensively. It is, however, more flexible than regular-lay rope, and the outside wires on the strands present a

greater wearing surface than in regular lay, as can be seen by comparing Figs. 6 and 7. Most all flattened-strand ropes are Lang lay, such as in Fig. 3. A worn flattened-strand rope is shown in Fig. 8, which indicates its large wearing surface.

Wire rope, as ordinarily constructed, has a tendency to unlay unless it is seized at the ends to prevent the strands untwisting. There is on the market wire rope in,

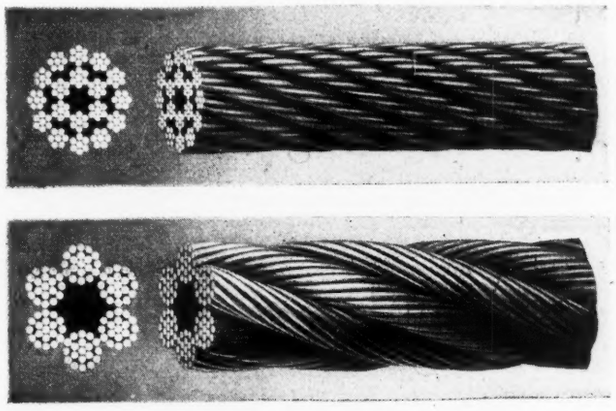


Fig. 9 (Top)—Two-layer combination Lang and regular-lay non-rotating rope

Fig. 10 (Bottom)—Single-layer combination Lang and regular-lay rope

which the wire is preformed to fit the twists in the strands and the strands preformed to fit the twist in the rope. This is sold under various trade names, but is generally known as preformed rope. This type of rope does not have a tendency to unlay. In fact, a strand may be taken out of a section and a wire taken from the strand. These may be returned to their original positions in the rope without disturbing the construction. These brands should not be confused with the non-rotating types.

A right-lay regular-lay construction is the one commonly used. In some cases left-lay ropes are used, such as for oil-well drilling ropes. For some elevator and hoist applications, left-lay is used in combination with right-lay rope, to produce a non-rotating combination.

As wire rope is commonly constructed, it will untwist if allowed to support a free load; in other words, it will rotate the load. There are non-rotating ropes made, but these are special constructions, one of which is shown in Fig. 9. This rope contains eighteen strands of seven wires each. The center of the rope has six strands left-lay Lang-lay about a hemp center. Around the center strands are twelve strands placed right-lay regular-lay. From this it will be seen that the two layers tend to twist in opposite directions and prevent rotation.

Fig. 10 shows a rope construction, the strands of which are twisted alternately left and right. Thus, when the strands are laid into a rope, they give a combination Lang and regular lay. When the rope is loaded, one lay tends to twist in one direction, while the other has the opposite effect and prevents rotation. There is a flat-strand rope construction *K*, Fig. 4, that is made non-rotating by using alternate strands twisted in opposite directions, giving a combination regular and Lang lay. The chief use for these ropes is on conveying machinery, but they are mentioned here as interesting constructions. In the foregoing only a few of the more common types of rope have been considered, particularly those that have been used for elevators. Rope manufacturers' literature on the construction, application and care of their products, contains much useful information, and the reader will do well to acquaint himself with these publications.

For assistance in the preparation of this article the author is indebted to the American Cable Company, the American Wire & Steel Company, John A. Roebling's Sons Company, Hazard Wire Rope Company, A. Leschen & Sons Rope Company, Williamsport Wire Rope Company, Broderick & Bascom Rope Company, and the MacWhyte Wire Rope Company.

Reducing Power Costs by Keeping Down Demand

By M. E. Wagner

A MAXIMUM demand charge in power rates has become a common practice. With such rates it is frequently possible to reduce the total charge for power by keeping down the maximum demand.

If there are a number of machines on the system that are not required to be in service continuously, it may be possible never to have them all in operation at the same time. The more evenly the machine's operation can be distributed over the day, the lower will be the power demand.

Electric furnaces are large users of power and are frequently not required to be in continuous operation. Instead of using one large furnace, if two one-half the size can be used and operated so that when one is on the line the other is off, their demand will be only about one-half that for the large furnace. Where such an arrangement can be used, it will result in a material saving in power costs.

When a furnace has been shut down for a month or more and it is to be put back into service, if it happened to be started near the end of the month, the demand charge would be the same as if it had been in operation the entire month. Planning so as to delay starting the furnace until the next month, a large saving can be made in the power bill. If the furnace required 500 kw. at a demand charge of $2 per kilowatt, the saving would be $1,000, something worth doing a little planning for.

Where machines can be shut down for short periods without interfering with production, such as air compressors and pumps, using a relay to cut these off the line when the load exceeds a certain value, a considerable reduction in the demand may result. Service water pumps generally discharge into storage tanks and are started and stopped automatically according to the water level in the tank. This level is usually between about three-quarters full and full. Under these conditions when the float switch closes to start the pump, the tank is three-quarters full. The pump might be delayed until the tank is one-quarter full, during which time the peak load on the system might pass.

There are available devices for automatically controlling the maximum demand of power systems. These may be used to control pumps, air compressors, refrigerating machinery, air furnaces or other equipment not essential to be in service continuously.

The foregoing suggestion cannot compensate for improperly applied and maintained motors and power drives, or for other ways that power is wasted. In any installation one of the first undertakings is to have equipment suited to the load conditions and to maintain it in good condition.

Gasoline Engines Drive Fireboat

THE successful fighting of any fire depends upon the power plant supplying the water. As the response must be immediate and the stand-by costs low, the gasoline engine is widely adopted for water works and for the propulsion and pump drive for fireboats. Such a power plant has been installed on the fireboat "J. H. Carlisle," owned by the city of Vancouver, B. C.

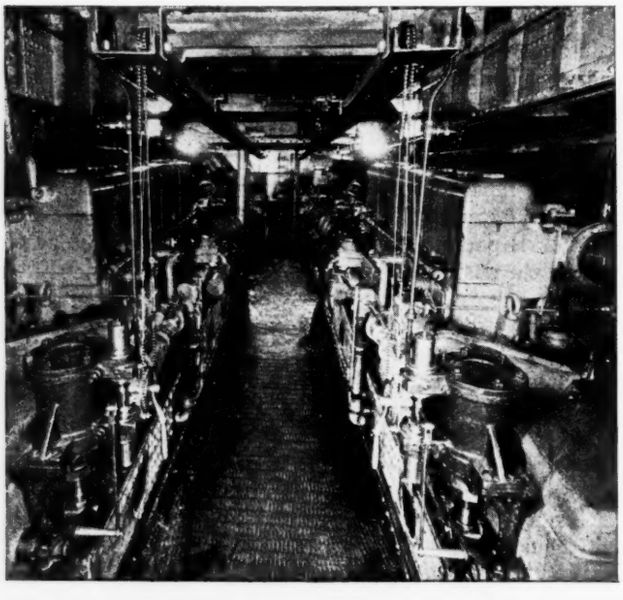
The plant consists of a six-cylinder 150-hp., 1,800-r.p.m. engine direct connected through a three-to-one reduction gear to the propeller, and two eight cylinder Sterling engines rated at 300 hp. each, direct connected by flexible couplings to 8-in. two-stage DeLaval underwriters centrifugal pumps.

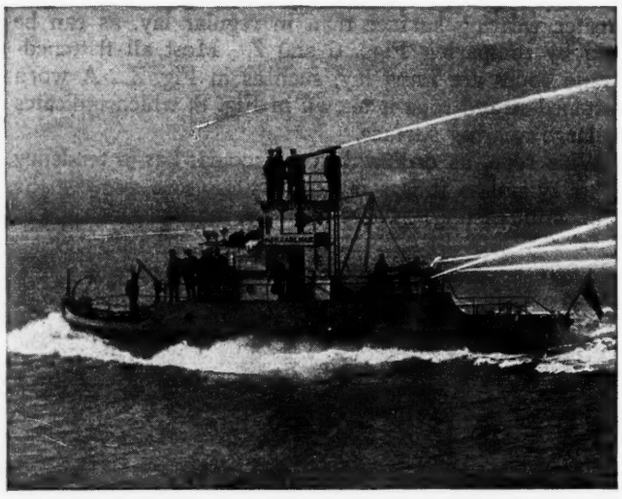
The machinery space is amidships under a raised deck 28 ft. in length. The fore peak compartment, separated from the engine room by a watertight bulkhead, has a storeroom and chain locker, while the after watertight compartment contains the main fuel tanks. On the forward part of the raised deck the pilot house is erected, with water-screen protection, and aft of the pilot house is a water tower 24 ft. high, carrying a 6-in. monitor having a capacity of 3,000 gal. per. min. A 4-in. monitor with a capacity of 1,500 gal. per min. is mounted on the flush deck forward and a third monitor, a 3½-in. one, of 1,100 gal. per min. capacity, is on the after part of the raised deck. There are also six hose connections forward and six aft.

It was required that these engines deliver at least 224 hp. each at the pump shaft at 1,400 r.p.m. in order that each pump should discharge 2,600 gallons per minute.

There are two independent suctions for the pumps, with a bypass system by which both pumps can draw from either suction, or both at once. This allows pumping to continue in case of either suction pipe becoming clogged. The pipe can be cleared by a reverse discharge of water through a suction clearing pipe, which is also arranged on a dual bypass system. In addition to running in parallel, discharging into a common pipe line at the normal pressure of 120 lb. to the sq.in., these pumps are arranged to work in series to give a discharge pressure of 250 pounds.

View of the engine room





The fireboat "J. H. Carlisle"

It was estimated that under single unit operation a 2½-in. stream of water was thrown 250 ft. in the air, with a nozzle velocity of approximately 125 ft. per sec., and with the same nozzle and both pumps working in series the stream was thrown 300 ft. vertically and nearly 500 ft. horizontally.

The monitors have been found very useful for increasing the speed of the boat over the nine knots obtainable with the screw propeller. With both pumping engines working and the streams from the monitors directed astern, a maximum speed of eleven knots was obtained. The original design provided for hydraulic propulsion alone and a speed of six knots was guaranteed, but it was decided that it would be better to have a separate propelling engine for maneuvering at the fire without drawing on the power of the pumps at a time when they would be required for fire fighting.

In addition to the actual pumping and propelling machinery there is a small direct-connected Universal generator set. Electric power is used to run the two engine-room ventilating fans and the priming unit, besides searchlight and ordinary electric lighting. No storage batteries are carried for this purpose, but for alternative power a shore connection can be plugged in, and there is an emergency lighting system connected with the starting batteries of the engines.

With a fuel capacity of 700 gal. of gasoline, the "J. H. Carlisle" will be able to work at full power for over fifteen hours without re-filling, as her gasoline consumption is about 40 gallons per hour when the two pumping engines are in operation.

On maneuvering tests she proved very handy, turning readily in an 80-ft. circle at full speed ahead, and coming to a dead stop in 1½ lengths, from full speed ahead.

The boat will be operated by two crews of six men each, of the Vancouver Fire Department; the crews stand a ten-hour day watch and fourteen-hour night watch. Her first master, Capt. R. F. Ross, has already taken charge.

Few attempts have been made to produce gasoline engines of this size and speed; that is, with cylinders of 8-in. bore and 9-in. stroke running at 1,200 revolutions. They are very finely balanced and have aluminum pistons of a special design. The crankshaft, which is counterweighted and dynamically balanced, is mounted in seven

main bearings, all bearings being fitted without shims. The cylinder construction includes a long water jacket with a removable cylinder sleeve, and the cylinder head is provided with dual valves for admission and for exhaust. A suction system extracts the fumes and relieves the compression in the crankcase so that the engine operates with a clean exterior.

In many cases where these engines are being employed, gasoline is purchased at 10 cents a gallon in bulk, making the combined initial cost and the running cost over a period of ten years much less than with any other type of prime mover, with the added advantage that the power is available instantly through the electric starter system.

The complete cost of the boat, including machinery, was $53,440; this total cost was only $75 above the designer's estimate. As this boat has exceeded her guaranteed speed of seven knots by over two knots with the propelling engine alone, and by four knots when using the monitor units to assist, and on her tests exceeded pumping requirements from 10 per cent to 15 per cent, the property owners of False Creek district, who guaranteed the cost of the boat, feel they have received excellent value for their money.

Professional Jealousy Pays no Dividends

By William S. Hobbs

WHAT man, in any profession whatsoever, has not seen the sidetracking and well-nigh ruin of at least one man's career through that absurdly petty vice—jealousy?

Jealousy has manifested itself in the musical world to a degree that would be almost ludicrous were it not so tragic. Singers intrenched in the hearts of their audiences and financially secure, view with real alarm a new star in the musical sky and dread acutely the critics' pronouncement "great." Artists vie for the title *"non pareil"* and grow sick when a colleague takes the annual prize at the exhibit. Actors cling to their rôles with a tiger-like tenacity, fearful that their understudies will prove to be their equals when given an opportunity to play the parts. Physicians treat with outward courtesy but with inner qualms the advent of the new young doctor in the community. And so it goes—lawyers, teachers, business men, preachers—yes, even the ecclesiastics are sometimes tainted in this way.

Nor is the engineering world free of the corroding influence of jealousy. I once had the misfortune of witnessing a young man forced to leave his firm because of the prevalence of this trait. Due recognition by his superiors of his worth was impossible because of the jealousy of their immediate subordinates. If the young man had a brilliant idea and worked it out satisfactorily in the plant, the head of the company never knew it. The man over him always managed to criticize the attainment, misrepresent it, or take the credit for himself.

Who hasn't seen one man do the "dirty work" and another receive the credit for the completed task? Naturally, such littleness rankles in the breast of the actual performer. This may be childish, perhaps, but is quite human.

Jealousy also may be human, but it is utterly foolish—it pays no dividends. Any man who thinks this out will recognize that it must be so. Hiding or belittling another fellow's good ideas, as a rule, won't "get a man anywhere." It may force the man misrepresented to seek another field, but it will never keep a good man down. Notice that I said a *good* man. Such paltry actions may induce in some few men a spirit of "What's the use? My idea won't 'get across' to the boss anyway." But the only way to keep ahead of the man with ideas is to sprout a few of your own. Be so good yourself that no matter how many and how good are the ideas of the "other fellow," there'll be room for you, too, at the top. For he'll get there anyway in spite of you, and representing him falsely to the chief won't get you anything but the "sack."

Did you ever notice that the man who gets promoted usually is the man that has ideas—who is willing to spend some time outside office hours thinking about his job? But you've noticed, too, that when he does go up the ladder several rungs, there are always a few chaps who cry, "Here I've slaved for this company for five years and what do I get for it?" These are the men who spend all their evenings at the night clubs and revues and who haven't had an idea concerning their work since they conceived the one that here would be a "soft" spot to spend their time.

Now, when the boss asks, "How's Jones—ever contribute anything to the firm?" why not put a hearty tone into your voice (even if it does make you slightly nervous) and say, "Why, yes, Mr. Superior, Jones is right there with the goods. He's always hatching out some idea or other and we've put several of them into effect with mighty good results." Or, better still, tell the boss about Jones without his asking. The boss won't think any less of you, and Jones will get what he deserves for using his head for something besides a support for his face.

Jealousy is puerile, disgusting, mean, disorganizing. Let's try to eliminate it from the engineering field and thus lend more dignity to the profession.

CHEAPER POWER THROUGH MODERN EQUIPMENT

Here is another way to obtain cheaper power through the use of modern equipment. Many articles have been written to show how the adoption of new combustion methods or the installation of modern boilers or turbines has made savings. But the article entitled "Simple Changes that Reduce Wastes Result in Large Savings," by H. W. Benton, in *Power* for January 22, will show how the purchase of new coal-handling equipment, with some minor expenditures for other equipment and for repairs, more than paid back the cost of the changes during one year's operation.

Experience with

Sodium-Aluminate Treatment For Boiler-Feed Water

Shows marked advantages:

Less excess chemicals .....

Less soluble salts .....

Low hardness .....

Less foaming .....

Less scale .....

By C. C. Spilman
Chemical Engineer, Henry L. Doherty & Co.

INTERNAL treatment makes a hot-process water softener out of the boiler. The heat breaks up the temporary hardness, calcium and magnesium bicarbonates, and they are precipitated as sludge. The permanent hardness, consisting usually of calcium and magnesium sulphates, does not precipitate out as sludge, but forms scale directly on the evaporating surfaces of the boiler. All internal treatments endeavor to prevent this scale deposition by transforming the calcium sulphate into calcium-carbonate precipitate and the magnesium sulphate into magnesium-hydrate precipitate.

Theoretically, soda ash, if fed in the proper proportions to the boiler, will prevent scale formation. It furnishes carbonate to prevent calcium-sulphate scale. It also breaks up in the boiler to form caustic soda and carbon-dioxide gas, the caustic soda reacting with the magnesium salts to form magnesium hydrate precipitate. In practice, however, it is found that the precipitates formed from the use of soda ash alone are very finely divided; they settle on the tubes, causing tube failures due to overheating, and they also increase the tendency to foam.

The problem to be solved by the writer was to standardize on a treatment that would be applicable to these plants located in different parts of the country, each presenting different conditions of boiler feed water, percentage return, load conditions, type of boilers, etc. The treatment could not be complicated, but must be easily handled and controlled by the average power-plant operator. It had to be chemically correct—that is, prevent scale and foaming. After a thorough study of the science of water treatment and the methods used by other companies, it was decided to base the internal treatment on the use of sodium aluminate in connection with soda ash.

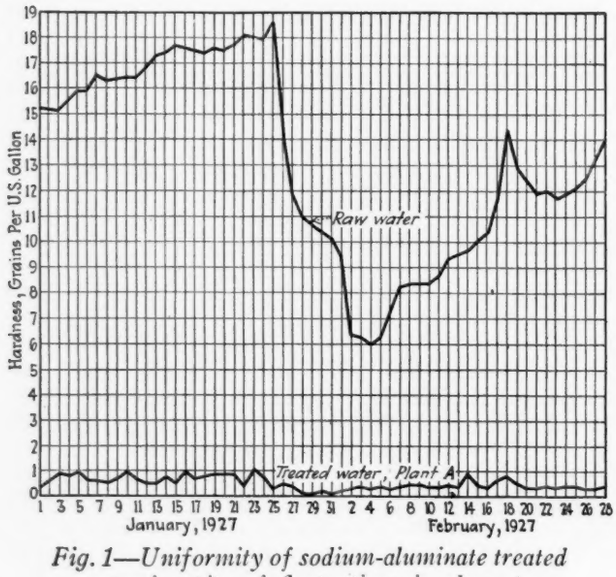


Fig. 1—Uniformity of sodium-aluminate treated water in spite of fluctuations in character of raw water

Sodium aluminate, as put on the market in solution with caustic soda and soda ash, was found to be a powerful coagulant. Precipitates formed by its use were in large particles and floated easily. Thus by reducing the number of particles in suspension, the tendency to foam is diminished, and, since the precipitate stays in suspension easily, it does not have a tendency to bake on the tubes.

In order to control this treatment, a testing outfit was furnished each plant and the operators instructed as to its use. In order to take care of fluctuations in the raw water, it is tested daily. A 24-hour sample of steam is collected from the header and tested each day, so that if foaming is occurring it may be detected. The treatment is controlled by testing each boiler in service each day. These tests are simple titrations with color indicators and hardness by the soap method. They are easily handled by the average operator. A report of these tests is sent to the laboratory daily on the blank forms furnished, and once a week samples of boiler and raw water are sent to the laboratory as a check on the operator's tests. The charge of soda ash is dissolved in water, the sodium aluminate added, and this treatment is fed into the boilers through the feed pump.

It is desired to obtain a water in the boiler of zero

hardness and with sufficient excess carbonates to prevent sulphate scale, this excess depending on the amount of sulphate present in the raw water; hence a different excess is necessary for each plant. A properly balanced boiler water should have zero hardness with the phenolphthalein alkalinity slightly greater than one-half the methyl-orange alkalinity. The latter should not be more than the sulphates. The total alkalinity for a properly balanced water varies with the character of the raw water, some plants getting zero hardness with about 10 to 15 grains alkalinity and others running from 50 to 75 grains. The operators soon learn how much excess treatment is necessary and also the limits to which they can go in concentration before foaming occurs. Foaming in a boiler depends not only on the concentration of the soluble salts in the water, but also on the amount of suspended matter. The writer's experience shows that a precipitate coagulated with sodium aluminate shows less tendency to foam than one precipitated with sodium silicate, sodium phosphate or soda ash alone.

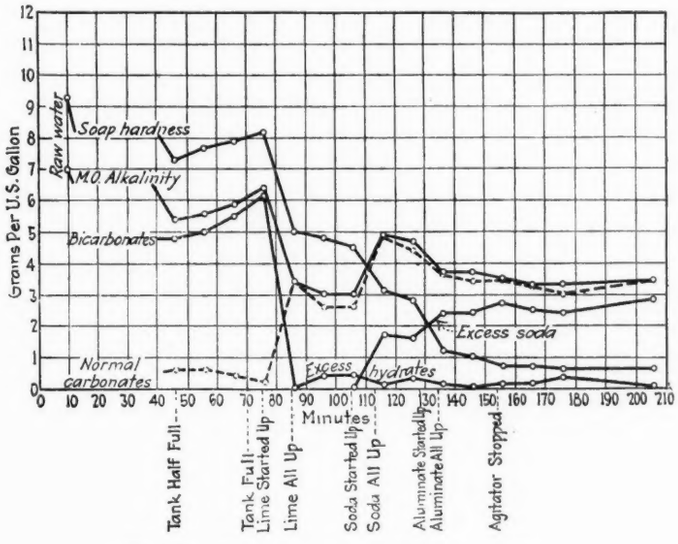


Fig. 2—Reactions in tank using sodium aluminate, plant "A"

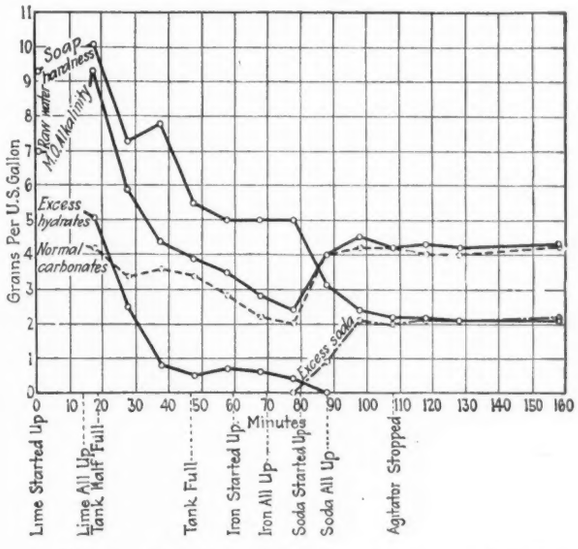


Fig. 3—Reactions in tank using iron-sulphate, plant "A"

By testing the raw water daily and anticipating the load on the boilers, the operator can secure a uniform treatment in the boiler in spite of changes in the raw water.

TABLE I—SODA ASH-SODIUM ALUMINATE TREATMENT APPLIED TO A VARIETY OF WATERS

State	Source	A.	G.P.	H.	C.
Ohio	Well	10.4	7.2	11.0	2.1
Ohio	Lake	6.6	11.5	12.4	1.1
Ohio	Canal	7.4	9.4	10.0	1.3
Ohio	City	4.1	7.6	8.4	1.0
Missouri	City	1.1	1.7	2.1	0.9
Wyoming	City	4.4	3.8	4.2	0.7
Louisiana	River	4.9	5.7	6.3	1.5

The figures given are in grains per gallon of calcium carbonate. A. is the total alkalinity to methyl orange. G.P. is the ghost point or false end point of the soap hardness and is the dividing line between the calcium and magnesium salts. H. is the total soap hardness. C. is the chloride content.

This soda-ash-sodium-aluminate internal treatment is not applicable only to one type of raw water, but has been successfully used in treating a variety of feed waters, as is shown in Table I.

External or Pre-treatment

External chemical treatment of boiler feed water has for its object the removal (to the lower limits of solubility) of all calcium and magnesium compounds. After reaction with the chemicals the water is filtered so that the only sludge formed in the boiler by evaporation comes from the small amount of residual hardness left in the treated water. The temporary hardness, or calcium and magnesium bicarbonates, is removed by the use of lime. Calcium sulphate is removed by soda ash, while magnesium sulphate requires both soda ash and lime. The completeness and speed of reactions in water softening, like all other chemical reactions, depend on the excess of chemicals used. The object is to get a water of low hardness with very small amounts of excess chemicals.

Three of our largest plants have intermittent cold-process lime-soda softeners of the most approved type. They are located on surface streams that vary in a wide range as to hardness and turbidity. The turbidity and suspended matter are removed by the use of a coagulant. Ferrous sulphate, more commonly known as iron sulphate, was used in these softeners as a coagulant. The ferrous sulphate combines with lime to form ferrous hydrate, a gelatinous precipitate, which "grabs" the colloidal and suspended matter and settles it to the bottom of the tank. This reaction leaves an equivalent amount of calcium sulphate in solution, which in turn is removed by soda ash. This leaves in solution soluble sodium sulphate in the proportions of about one-half pound sodium sulphate for every pound of iron sulphate used. On very turbid waters it is necessary to use as high as a pound of iron sulphate per thousand gallons, thus raising the soluble salt content of the treated water about 3.5 grains per gallon. Sodium aluminate solution for use in cold-process lime-soda softeners is made with a higher concentration of sodium aluminate and a smaller percentage of caustic soda. Sodium aluminate, being an alkaline coagulant, does not require additional lime or soda ash to react with it and even helps the softening reaction rather than opposing it. By its use no additional soluble salts are left in the water, which fact has a very important bearing on the fuel loss due to blowdowns.

When using the lime-soda-iron treatment, it is necessary to depend on the results of the previous tank in order to calculate the treatment for the next tank. When

the quality of raw water is uniform, this system is satisfactory, but the usual surface stream is subject to wide fluctuations due to heavy rains, ice breaking up, etc. In such cases a variation of several grains is possible in the raw water between tanks, so this method of calculating treatment fails to produce a uniform water.

One of the advantages, peculiar only to the use of sodium aluminate, is that the treatment is based on raw-water analysis. A titration test is made on the raw water as the tank is filling, and the proper amounts of lime and soda ash are calculated, as well as the lime slaked and ready to go up, before the tank is full. Fig. 1 shows how uniform a treated water is obtained at plant "A" in spite of the wide fluctuations in the raw water.

The softener at this plant consists of three 50,000-gal. reaction tanks. About 75,000 gal. of water a day is treated and fed as makeup to one boiler: all the other boilers are fed by condensate from surface condensers. This makeup boiler operates at 250 lb. pressure and is a 1,300-sq.ft. horizontal water-tube type. The tubes have a slight chalky deposit, hardly thick enough to call scale.

In order to show the effect of sodium aluminate in completing the reactions of the lime and soda ash, the following analyses are shown in Table II.

TABLE II—EFFECT OF SODIUM ALUMINATE IN COMPLETING REACTIONS OF LIME AND SODA ASH

Tank		P.	M.	H.	OH.	C.	N.
1	Before	2.9	5.3	3.3	0.5	4.7	1.4
	After	2.8	5.1	1.5	0.5	4.6	3.1
2	Before	3.0	4.8	2.3	1.2	3.6	1.3
	After	3.1	4.9	0.9	1.3	3.6	2.7
3	Before	3.0	5.2	2.4	0.8	4.4	2.0
	After	2.4	4.3	0.2	0.5	3.8	3.6
4	Before	2.2	4.0	3.0	0.4	3.6	0.6
	After	1.6	3.1	0.7	0.1	3.0	2.3
5	Before	2.4	4.2	1.9	0.6	3.6	1.7
	After	2.0	3.3	0.4	0.7	2.6	2.2
6	Before	1.8	4.4	2.8	0.0	3.6	0.8
	After	1.7	3.3	0.7	0.1	3.2	2.5

Note:—P.—Phenolphthalein alkalinity. M.—Methyl orange alkalinity. H.—Soap hardness. OH.—Excess sodium hydrate. C.—Total carbonates. N.—Excess carbonates—soda ash.

The analyses "before" were made on samples taken after the lime and soda ash had been reacting about twenty minutes and just before the aluminate was added. The analyses "after" were made on samples taken about an hour after the paddles were stopped. Both samples on each tank were tested at the same time so they had an equal time to react.

The progress of the chemical reactions in the softening tanks is shown in Figs. 2 and 3. A tank was treated in the regular way, using lime, soda ash, and sodium aluminate. A sample was taken when the tank was half full and every ten minutes thereafter until the reactions were complete. The lime was added when the tank was full and the tests made before that show the effects of mixing the sludge from previous tanks with the incoming raw water. The pipe from which the samples were drawn extends into the tank about fifteen feet from the top of the water. Trouble was had with the raw-water pump on the sodium-aluminate tank and as a result it took 70 minutes to fill the tank instead of the usual 45. The reactions were practically complete one hour and a half after the tank was filled. A clear sample was drawn from the sampling pipe 45 minutes after the agitators were stopped. Since the sludge settled about fifteen feet during that time, no doubt the tank could have been turned into the filters twenty minutes after stopping the paddles.

Fig. 3 shows the reactions in a tank using iron sulphate. In this case the lime is added when the tank starts filling up. The water cleared in practically the same time as in the aluminate tank.

Both tanks had the same raw water and the same amount of chemicals, the iron tank, of course, having in addition the proper amount of lime and soda ash to react with the iron sulphate. There were used 0.31 lb. of sodium aluminate and 0.4 lb. of iron sulphate per thousand gallons of water. The raw water contained 16 grains of soluble salts per gallon, the iron tank 10.9 and the aluminate tank 7.5 grains.

The effect of using sodium aluminate is shown in the final hardness of the treated water in the two tanks. Both tanks have zero excess caustic soda; the aluminate tank has 2.8 grains excess soda ash and the iron tank 2.2 grains. However, the aluminate tank has 0.6 grain hardness and the iron tank 2.0 grains.

Experience at Plant B

Plant "B" consists of four 150,000-gal. reaction tanks which treat nearly one million gallons of water daily. The plant has jet condensers, hence the treated water is 100 per cent makeup. This plant experienced a great deal of trouble with lime-soda-iron treatment due to foaming and slugs of water getting in the steam lines and turbines. This caused high turbine maintenance due to reblading; a safety factor was also involved because many of the steam-header valves were inoperative. To help the foaming in the boilers, the excess soda ash carried in the treated water was cut more than half. This diminished the foaming, but allowed a hard sulphate scale to form. Upon the writer's recommendations the iron sulphate was eliminated and the use of sodium aluminate started. Almost immediately foaming was stopped and higher concentrations were carried in the boilers without trouble. It was several months before the sulphate scale was entirely removed, but now they have a properly balanced water that does not scale or foam.

In a plant treating this amount of water the question of cost is a serious one. Table III gives the cost data for several months.. Since November, 1926, the cost averaged a little lower than iron-sulphate treatment and much better water was obtained.

TABLE III—COST DATA WITH SODIUM ALUMINATE TREATMENT—PLANT "B"

Month	M. Gal. Filtered	Hardness: River	Hardness: Treated	Lb. per M. Gal.: Lime	Lb. per M. Gal.: Soda	Lb. per M. Gal.: Aluminate	Cost of Chemicals per M. Gal.: Lime	Soda	Aluminate	Total
May, 1926	27,836	7.27	2.02	0.373	0.851	0.477	$0.0040	$0.0121	$0.0225	$0.0386
June, 1926	28,959	6.53	1.62	0.382	0.795	0.435	.0041	.0113	.0205	.0359
July, 1926	27,337	7.11	1.55	0.366	0.896	0.444	.0039	.0128	.0209	.0377
Dec., 1926	19,632	5.7	0.75	0.51	0.714	0.216	.0043	.0102	.0113	.0258
Jan., 1927	22,494	6.2	1.07	0.54	0.93	0.23	.0046	.0133	.0120	.0300
Feb., 1927	23,071	4.56	1.26	0.381	0.66	0.28	.0032	.0094	.0146	.0274

Summarizing the foregoing, we find that in internal treatments sodium aluminate acts as an efficient coagulant and permits a scientific control. In external or pre-treatment it gives us a water of low hardness with very little excess chemicals, a water with less soluble salts than one treated with iron sulphate, and a water that is properly balanced so as not to cause foaming or scale formation.

The writer's experience during the last year and a half leads him to conclude that sodium aluminate is a valuable contribution to the science of boiler water treatment.

Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Ball Thrust Bearings Destroyed in Elevator Machine

A SMALL electric passenger elevator developed a grinding noise in its gear case. An examination showed that the gear teeth were badly cut and worn, and the worm shaft had excessive end play. When the worm shaft was removed, the ball-type thrust bearings were found to be destroyed.

The trouble was apparently caused by the thrust bearings wearing and allowing end thrust of the worm shaft. After this occurred, the worm-shaft thrust pounded the balls to pieces. Parts of the balls worked out into the lubricant and were carried in between the worm and gear teeth, causing rapid wear of these parts.

When the worm shaft or gearing has excessive end play, its cause should be found and rectified. Trouble of this kind is sometimes indicated by movement of the car when a load is placed on it. Large end play of the worm shafts causes severe hammering of the motor's armature as it moves endwise with changes of load, which is likely to bring on electric trouble. W. E. WARNER.

Brentford, England.

Addition to Plant Sometimes Not Needed

THERE are times when an industrial plant management will find itself faced with a shortage of steam or electricity and will take steps to increase the size of its power plant without thorough study of the situation. Often such an investigation would show that for a small investment in auxiliary equipment or in the rehabilitation of the existing auxiliaries, large expense for new boilers or prime movers could be avoided.

A case in point from the writer's experience will illustrate what is meant. In a large silk mill new manufacturing equipment was installed and the management found that there was not enough current being generated to take care of the load at certain peak periods. They were about ready to purchase new boilers and a new generating unit, when the writer suggested the wisdom of surveying all the uses of power in the plant and endeavoring to get the needed additional current by making savings somewhere else. This thought was suggested because the balance between steam and electricity was good in the existing installation, but would be thrown way off if new boilers were put in, necessitating the waste of a large amount of heat in condenser water and exhaust throughout the year.

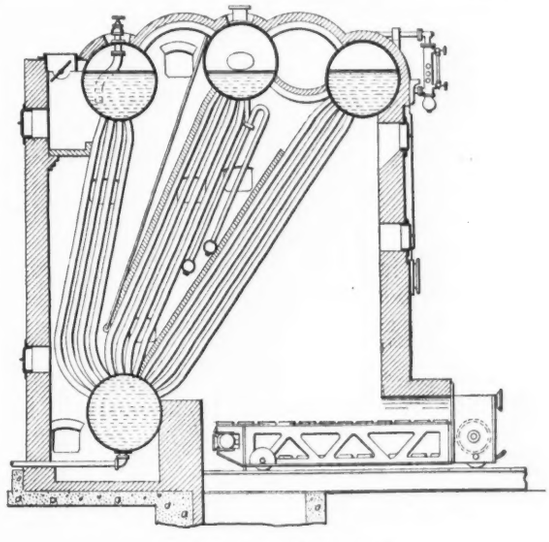
A silk mill has a large amount of shafting and belt drives. The study showed this shafting to be absorbing a great deal of the current generated, simply to keep it turning over when it was doing no useful work at all. It was determined to replace all the plain-bearing hangers on this shafting with a high grade of ball-bearing hangers. This was done. The result was far beyond our calculations. Not only was there enough power available to carry the increased load without the installation of new generating equipment, but there was actually an excess sufficient to take care of a future increase in the load of considerable proportions.

Here was a case where a relatively small investment in one type of equipment obviated the immediate investment of a much larger sum in another type. Of course this cannot often be done. But occasions frequently occur to warrant complete plant studies being made before plant enlargements are authorized.

Indianapolis, Ind. JOHN WALLACE.

Stopping Air Leakage

OUR plant is equipped with stoker-fired water-tube boilers of the type shown in the illustration. We had never been able to obtain the efficiency we had been led to expect. As we had no flue-gas analyser it was impossible to ascertain what percentage of excess air we



Original setting used

were getting, although the high gas temperature led me to believe that the loss was high.

Finally, the management was persuaded to get a CO_2 apparatus and through this found that the excess air was over 50 per cent.

As the setting was tight, we were at a loss to locate the leakage until by chance we discovered that the air came through at the end of the traveling grate.

The coal we use has a fine ash, and this would not pile up under the stoker to reduce the air flow on light loads when the rear end of the stoker was more or less bare.

The trouble was corrected by rebuilding the bridge wall with an overhang extending out over the end of the stoker a distance of twelve inches. This does not interfere with the ash on heavy loads and does largely reduce the air leakage on light loads. S. ABRAMS.

Newark, N. J.

Vibration Caused Field-Coil Failure

A 750-KW. turbine alternator developed an open circuit in the rotor winding when operating at full speed, but when not running no defect could be found by test. When the rotor was opened, a break was found in the crossover connectors between two coils. This fault was caused by the connector not being properly secured. When the machine was running, centrifugal force caused the joint to open and break the circuit between the coils. When the machine was not running, the faulty connection made contact and gave a satisfactory test. The joints were remade and the connector was securely braced to a fiber block to prevent movement, which was the original cause of the trouble.

Leaving leads and connectors loose on rotating machinery is inviting trouble. The centrifugal force, when running, forces them outward. Continual movement of coils will cause joints to loosen, and if they rub, the insulation will be worn through to the bare copper. Vibration of the lead will cause joints to crystallize and loosen. Vibration can be prevented only by firmly bracing the joint so as to prevent any movement.

London, England. E. W. West.

Improving Operation of Small Plants

THERE are many plants of about 500 hp. the operation of which is not as efficient as it might be, and yet the employer may find it difficult to get a man to take charge who will exert himself to see that the equipment operates at its best.

The expense of producing heat, light and power is often low when compared with the general costs of manufacturing, so that many concerns are content if their engineers rank high in sobriety, loyalty and reliability, although somewhat lacking in knowledge or efficiency.

It sometimes helps to purchase the power from the central station, but even then the steam for heating has to be generated, and in this there is a field for improvement.

In many a plant we find a man in charge who is faithful as far as being on the job is concerned, but he has been in this one plant for years and has forgotten much that might be of advantage to him. He also feels that he can take things easy, for he has worked hard in previous years. Likewise, his employer feels that he is an old employee and must be kept as long as he can work.

This idea is all right, but let us suppose that the plant is in a state where the engineers are licensed, and that it requires a man with the highest-grade certificate. We will assume that a man is engaged who has just been granted his first-class license. He often takes the job with the idea that it is but a step to a larger plant, and when, after a few years of good operation, he has reached the limit of salary, he goes to something better. No matter whether the salary in question is higher than customary for that size of plant, he feels that for a larger one it will be better.

So the employer is back where he started and has to begin again. The question seems to be, Can we get an efficient man and, having secured him, can we depend upon him to stick to the job and keep his efficiency? In the case of the first man not only he but the men under him were of long service and were getting by as easily as possible.

The problem of the fireman is also vexing, since a good man expects to become an engineer, and one who does not will be lacking in most good points. It is a foregone conclusion that most firemen will not remain in the boiler room any longer than possible, and many feel the job is more or less degrading.

In many hand-fired plants a distinct improvement can be made by changing to oil, pulverized coal or mechanical stokers. But suppose any of these methods are adopted, of what use will they be if they are neglected? The fireman will make as little effort as possible to keep them up if the engineer does not maintain a close supervision, and in the case of the man of long service this supervision is likely to be desultory.

I recently visited a plant where a stoker had been installed and found the fireman working through the doors much of the time. What is the benefit of installing such a machine if one of the principal sources of loss in hand firing is to be continued?

At one time a certain type of hand stoker was installed in a plant, but the fireman seldom used the moving bars as it was intended they should be used.

There are instances of mechanical draft used only when the pressure has been allowed to drop and then run at full speed with no attempt at automatic regulation; tube blowers used infrequently, if at all. Many other things like these the engineer does not see because he is occupied with duties in the engine room.

Let us consider a plant that has one of the arm-chair engineers, a high-priced fireman and a boiler equipped with a stoker and necessary instruments for draft regulation, etc. Most plants of this type have extra laborers and having them do all work of cleaning and coal and ash handling, the fireman can be discharged and an engineer obtained who will watch the steam generator with care and the engine room at the same time.

The money saved from the fireman's wages could be added to the engineer's salary, so that it would be worthwhile, and at the same time the increased efficiency of the plant would return a handsome saving to the owner. There are possibilities in such a course that should appeal to both engineer and management. G. H. Kimball.

Cambridge, Mass.

Repairing a Damaged Bearing

WE HAVE a 360-hp. oil engine in our plant that developed a pound some time ago. As soon as it was possible, the unit was shut down and an inspection made.

Upon removing the crankshaft bearings, one was found badly damaged. The babbitt lining of the steel-bearing shell was checkered with many lines of fracture. Several pieces of babbitt were loose from the shell and were held in place solely by the irregularities of the fractures.

As there was no extra bearing on hand, we were forced to do something to permit the temporary use of the old bearing. Consequently, all the loose particles were cleaned out and the shell washed with a caustic-soda solution to clean the surfaces. The shell was then warmed slightly and molten solder run in to fill all the crevices. After touching up the rough spots with a scraping tool, we placed the bearing in service and ran for three months until a new one was secured from the builder. S. Abrams.

Jersey City, N. J.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

How Leaky Gage Cocks Were Avoided When Using Soda in Boilers

I HAVE read the letter of M. W. Eastman on page 979 of the Dec. 11 issue and believe he gives an incorrect impression in stating that "the soda in the water was the cause of gage-cock leakage." Soda is used in many boilers and its use has no effect on the gage cocks so far as causing leakage is concerned.

Undoubtedly, the soda treatment of the boiler water has resulted in the formation of a sediment in the boiler instead of a hard scale forming on the boiler tube. The trouble experienced with gage-cock leakage may very likely be due to the sediment getting under the gage-cock seats and preventing them from closing tightly. While the soda treatment may thus be the underlying cause of the gage-cock leakage, the action is quite different from that indicated by Mr. Eastman. If the cocks have hard metal seats and the columns and cocks are well blown down, the use of soda should not cause gage-cock leakage.

Toronto, Canada. J. THORN.

* * * *

Boiler-Room Instruments or Automatic Combustion Control

IN HIS discussion of the relative fields and merits of automatic combustion control and of boiler-room instruments in the Dec. 4, 1928, issue, L. W. Hayward makes a number of pertinent statements that perhaps may give a wrong impression if accepted entirely at their face value. He states that with the proper sort of boiler-control instruments (the writer infers that he means flow meters, draft gages, CO_2 recorders and pyrometers) an intelligent operator can tell when his economy falls off and, if he be a skilled diagnostician, can correct the conditions. On the other hand, Mr. Hayward believes automatic combustion control may not accomplish this, owing to the fact that it has been co-ordinated only at the time of its installation, and with changing fuel and boiler conditions cannot hope to be continuously accurate. He states that in many plants he has seen automatic combustion control that never has been readjusted.

The writer ventures to guess that the boiler-room instruments, if any, in these plants would have been found to be in a bad state of repair or in disuse and that the type of firing help was such that they could not, or would not, allow the instruments to help them in any way. The point is that the type of firing-room personnel that would avail itself of the advantages to be derived from boiler-room instruments, also would secure the maximum possible advantage from a properly designed and installed system of automatic combustion control.

Within the last few years combustion-control machines and methods have shown great improvement. A properly designed system of automatic control can accomplish results with greater precision than any fireman, no matter what his ability or experience. The fireman cannot directly proportion fuel and air to each other and to the steam demand with the help of any meters that have so far come to the writer's knowledge, yet a properly co-ordinated system of combustion control will do exactly this. In addition, it has been the writer's experience that, when a control system has been properly installed and the operating personnel properly instructed in its use, the men will be able to diagnose changing plant conditions just as well from the relative operation of the combustion-control machines as they could from a meter or combination of meters.

In conclusion, the writer believes wholeheartedly, with Mr. Hayward, that even the best automatic-control system will function better if used in conjunction with boiler-room instruments and intelligent personnel. Without this third factor it is his opinion that automatic control is better than boiler-room instruments can hope to be.

B. A. WEIMER, Engineer,
Chicago, Ill. Carrick Engineering Company.

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Cost of Preparing Powdered Coal

AN EDITORIAL in the Oct. 23, 1928, issue entitled "Cost of Preparing Powdered Coal," seems to discredit the use of powdered coal under steam boilers. The first point brought out is that the power requirements exceed those of the stokers. While this is true, it is not of great importance. The cost of power used in the preparation of powdered coal is a small item in the cost of making steam or producing electrical energy. What the operator or owner is interested to know is the total cost of producing steam or electrical energy in a stoker-fired plant compared with a plant using pulverized coal.

The accompanying diagram, taken from a paper on "Powdered Coal for Steam Purposes," by the writer and Martin Frisch before the World Power and Fuel Conference in London, is an analysis of the cost of eighteen representative American power stations. Six of these are fired with underfeed stokers, five with chain-grate stokers, one with oil and six with pulverized coal. This analysis includes the cost of installation as well as the operating cost. Whenever possible the costs were segregated into separate items. The figure consists of six charts; the most interesting are the second and the fifth from the top. The second chart from the top gives the total cost of the plant. It shows that the pulverized-coal plants cost less, if anything, than the stoker plants. This is contrary to the general impression that the engineering public receives from the current talks on the cost of plants.

The fifth chart gives the cost of power per kilowatt-hour. Although the preparation and the burning of pulverized coal may require more power than stokers, the total cost of the power generated by the station is appreciably lower than it is with stoker-fired plants.

The table is taken from the same paper and gives the detailed costs of pulverized coal in several central stations. The cost ranges from 22.8 to 35.31 cents per ton. This is the item in the cost of power production that the advocate of stoker firing is using in his favor. He usually adds this item to the cost of coal without considering

other items in the cost of producing power.

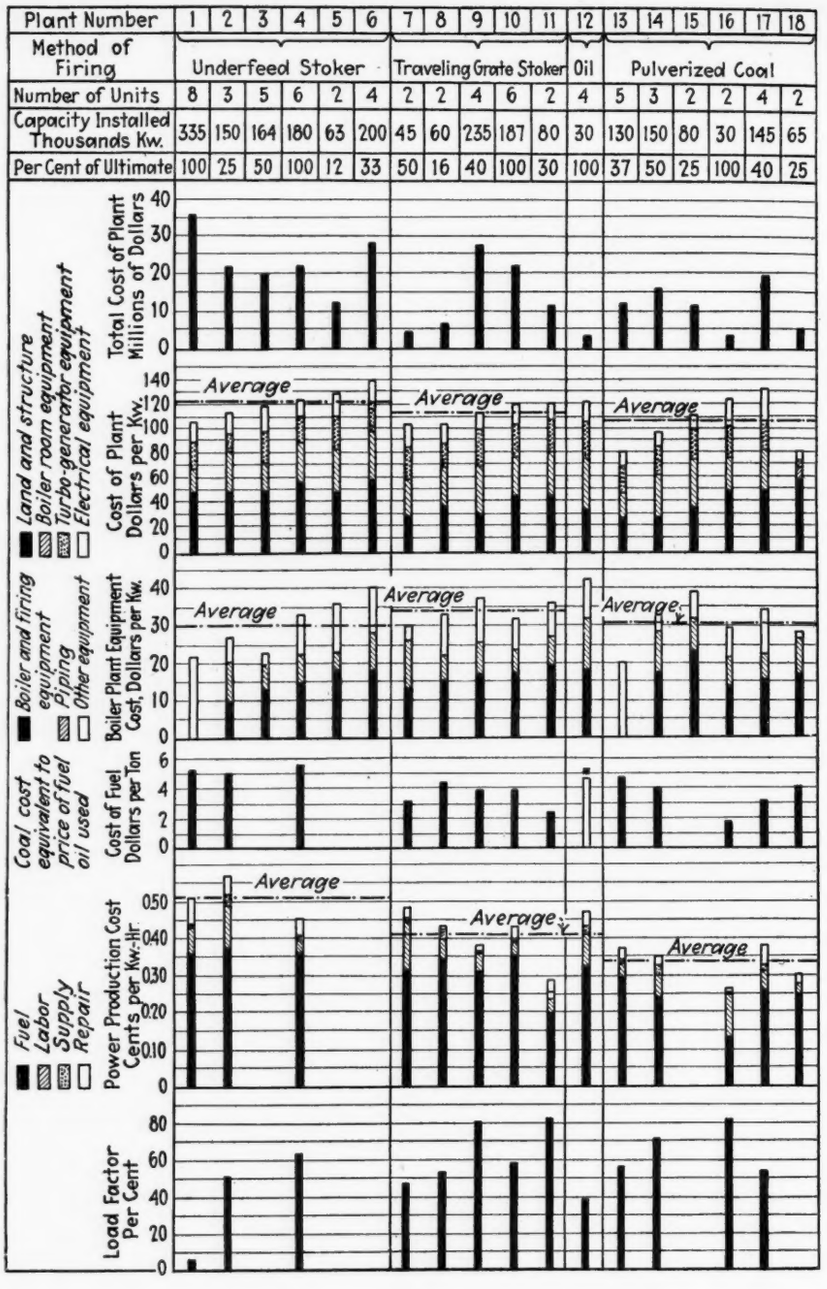
The second point brought out by the editorial is, to what extent is preheated air used for drying coal in the unit system in small plants? The answer to this query would be that it is done to a very large extent. This air is taken from an air heater, hollow furnace walls, hollow furnace bottom or from a special small heater in which the air is heated by steam.

The next point brought out by the editorial is that most of the industrial plants have refractory furnaces that will stand only when a large percentage of excess air is used. While this is true of the pulverized-coal furnaces, it is equally true of stoker-fired furnaces. Ten to twelve per cent CO_2 in the flue gases is usually considered low CO_2 content for powdered coal. It is, however, a good performance for a stoker installation. When this is taken into consideration, the maintenance of the pulverized-coal furnace is not much higher, if any, than the stoker-fired furnace.

The last point brought up is that more instruments are required to operate a pulverized-coal plant than in a stoker plant. This is hardly true. The same instruments that should be on a stoker-fired furnace do very well on a powdered-coal-fired furnace. Usually, the steam-flow air-flow meter is about all that is required for powdered coal. When the operator sets his furnace conditions, they stay so until he makes other changes. With a stoker-fired furnace, after the air adjustments have been made, the fuel-bed conditions may change and upset the adjustment previously made by the operator.

HENRY KREISINGER.

New York City.


Plant Number
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Method of Firing
Underfeed Stoker
Traveling Grate Stoker
Oil
Pulverized Coal
Number of Units
8 3 5 6 2 4 2 2 4 6 2 4 5 3 2 2 4 2
Capacity Installed Thousands Kw.
335 150 164 180 63 200 45 60 235 187 80 30 130 150 80 30 145 65
Per Cent of Ultimate
100 25 50 100 12 33 50 16 40 100 30 100 37 50 25 100 40 25
Total Cost of Plant Millions of Dollars
Land and structure
Boiler room equipment
Turbo-generator equipment
Electrical equipment
Cost of Plant Dollars per Kw.
Average
Boiler and firing equipment
Piping
Other equipment
Boiler Plant Equipment Cost, Dollars per Kw.
Coal cost equivalent to price of fuel oil used
Cost of Fuel Dollars per Ton
Fuel
Labor
Supply
Repair
Power Production Cost Cents per Kw.-Hr.
Load Factor Per Cent

COAL PREPARATION COST IN TYPICAL PULVERIZED COAL PLANTS

Data Taken from Prime Movers Committee Report, N.E.L.A.

Company	Cleveland Electric Illuminating Co.,	Detroit Edison, Trenton	Duquesne Light Co.,	Illinois Electric Power Co.,	Pennsylvania Water Co.,	Colorado Power and Light Co.,	Sioux City Gas and Electric Co.,	Union Electric Light and Power Co.,	Wisconsin Traction Co.,	Texas Power and Light Co.,
Plant	Lakeshore	Channel	Colfax	Peoria	Holtwood	Valmont	Sioux City	Cahokia	Appleton	Trinidad
Coal milled, tons	259,821	423,906	307,157	138,675	47,234	117,244	54,540	427,064	63,105	126,541 (6 months)
Tons coal per mill hour	5.26	6.71	.....	6.75	6.89	6.3	7.41	.....	5.86	.....
Kind of coal	West Virginia	West Virginia	Pittsburgh Bituminous	Illinois Bituminous	Bituminous and Anthracite	Colorado Lignite	Midwestern Bituminous	Illinois Bituminous	Illinois Bituminous	Texas Lignite
Costs	Bituminous	Bituminous								
Energy	9.0363	7.97	....	8.81	....	....	9.83	7.29	14.22	.....
Operating labor, cents per ton	4.5650	7.08	....	3.25	23.2	5.8	16.4	10.35	9.79	10.96
Operating material, cents per ton	0.3618	0.93	....	0.88	4.7	0.5	0.52	.....	1.02	0.76
Maintenance labor, cents per ton	2.9830	2.74	1.46	3.48	6.0	1.0	3.8	11.05	2.78	1.45
Maintenance material, cents per ton	5.4653	3.59	1.83	4.76	23.6	0.3	4.76	.....	2.73	.013
Total preparation costs, cents per ton	22.4114	22.31	.....	22.28	.....	.....	35.31	28.69	30.54	.....

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

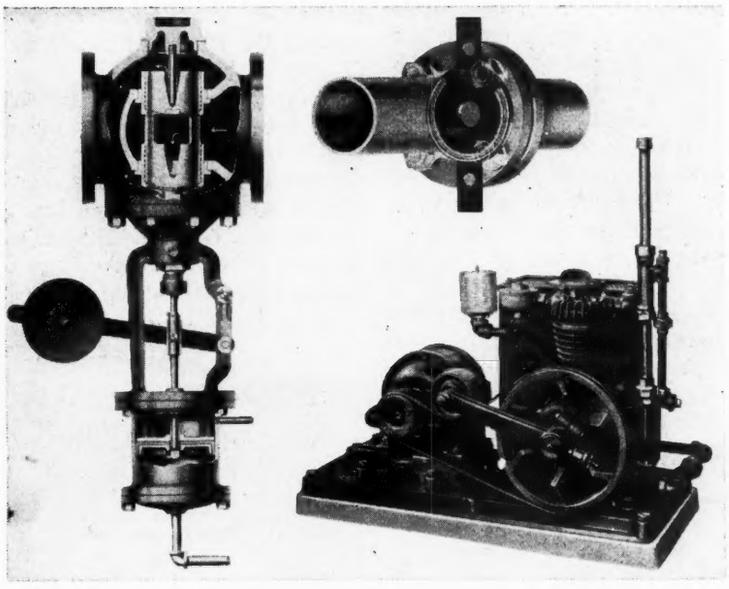


Fig. 1—Main-steam-control valve, metering orifice, and combination oil and air compressor used in the "Moderator System"

A Heating System Controlled by the Weather

A NEW development in steam heating, designed to vary the steam supplied to the entire heating system and to all parts of it in accordance with changes in demands resulting from changes in weather and occupancy conditions, has been brought out by Warren Webster & Company, Camden, N. J. The equipment gives full automatic regulation of steam supply for changes in outside temperature. It compensates for radiation shut off by hand, for variations in pressure of steam supply and vacuum in the return lines. Manual control is also provided so as to permit quick heating up and to prevent overheating during the night load. This system, called the "Moderator System," is intended primarily for large heating installations.

The amount of steam delivered to the radiators depends upon the pressure difference between supply and return, together with the resistance to flow in the system. In the Moderator System this resistance is made up of two elements—a small element due to the restriction of pipe and fittings, and a large element due to the installation of metering orifices. Intermediate meter orifices are located in the branch mains and risers of the steam-supply piping and are marked *Imo* in Fig. 3, a diagram of the system. Each intermediate orifice sets up sufficient resistance so that the steam flow is proportional to the requirement of the section served.

Meter orifices, marked *RO* in Fig. 3, are installed in the supply valves of each radiating unit and sized to pass the proportional amount of steam required for the unit. The size of the opening in each orifice is individually calculated from the radiation or heat loss and piping data for the building as furnished by the designing engineer.

A combined air compressor and oil pump in the basement supplies compressed air at constant pressure through the small pipe, shown solid in the diagram Fig. 3, to a roof thermostat. The amount of air flowing past the valve of the roof thermostat and into the line *AB* is varied by changes in outdoor temperature. This air is continuously discharged to the atmosphere at *B* through a restricted opening with the result that a pressure is maintained just ahead of *B* which is proportional to the outdoor temperature and equal to the pressure difference that should exist between the supply and return of the system in order to provide proper heating.

The area of the restricted opening at *B* may be changed by the operating engineer by moving the lever *C*. Reducing this opening increases the pressure ahead of *B*, while increasing it decreases the pressure. Thus the pressure ahead of *B* is always under the influence of both the roof thermostat and the operating engineer. The air pressure produced is always the result of the operation of both the roof thermostat and the hand control lever. This air pressure is applied to a mercury balance *D*, which mechanically actuates an oil pilot valve *E*.

Oil pressure is maintained by a pump built into the air-compressor unit. Movement of the oil pilot valve in one direction sends additional oil to the operating piston of the main steam-control valve, opening this valve and increasing the steam supply until the difference in pressure between supply and return is made equal to the air pressure ahead of

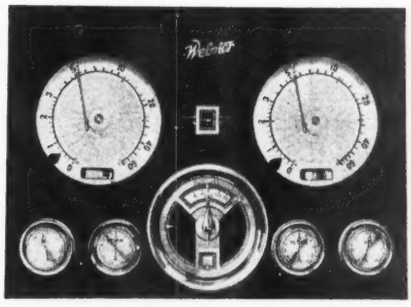


Fig. 2—Standard Control Panel

B. Movement of the oil pilot valve in the opposite direction produces an opposite effect by permitting oil to flow from the operating piston of the main steam-control valve back to an oil reservoir.

Changes in demand for steam may result from shutting off or turning on radiation. Also, an increase in

supply, not needed, may result from increased pressure ahead of the main steam-control valve or from an increase of vacuum in the return. These conditions tend to change the difference in pressure between supply and return, which must be kept the same as the air pressure ahead of *B*. These changes are corrected by a duplicate mercury balance *F*, which is connected to the supply and return mains through pipes *GF* and *HJ*.

Departure of the difference in pressure between these two points from that called for by the air pressure head of *B* results in movement of this second mercury balance, also connected to the oil pilot valve E, accomplishing an adjustment of the main control valve so that the pressure difference is again made equal to the air pressure ahead of *B*.

Movement of the lever *C* from the normal to, say, 120 per cent restricts the opening at *B*, thereby increasing the pressure ahead of it and supplying the entire system with 20 per cent more steam than would be normally required for the outside temperature. Through this means also, the heating up period may be speeded or the night load may be decreased.

The air-compressor and oil-pump unit shown in Fig. 1 consists of a single-cylinder air-cooled compressor of 4 cu.ft. per min. capacity. The oil pump, of the piston type, is mounted on the crankcase and driven by a cam on the compressor crankshaft. The unit is driven by a $\frac{3}{4}$-hp. motor through a leather belt and consumes approximately 500 watts an hour. Fig. 1 also shows the main steam-control valve, which is fitted with V ports specially designed to pass the quantity of steam determined by an analysis of the installation, and the method of installing the $\frac{3}{16}$-in. brass-plate orifices between two copper and asbestos gaskets.

The roof thermostat consists of two 7-ft. tubes, one of steel, the other of brass. The difference in linear expansion of these two metals serves to operate the air valve, which varies the flow of air in proportion to changes in outdoor temperature. The thermostat proper is provided with a shield so that it is not influenced by direct radiation from the sun. The air valve actuated by the thermostat is protected by an air cleaner of fine mesh monel-metal screen and the valve parts are maintained at a constant temperature through steam jacketing.

Fig. 3 shows the front of a standard control panel of the double instrument type. It contains the mercury balances that actuate the oil pilot valve and also instruments that indicate and record the air pressure and the pressure difference between supply and return of the heating system.

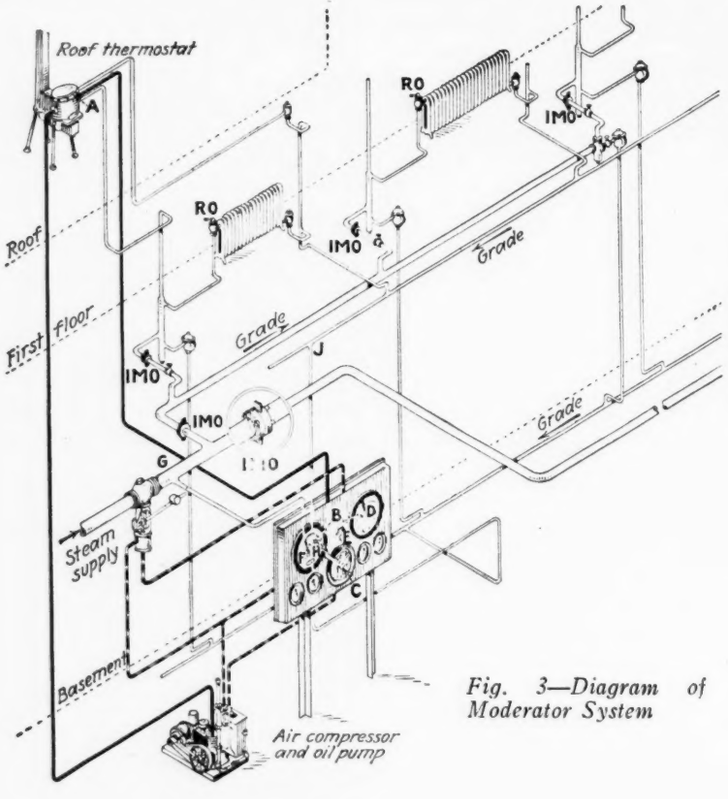


Fig. 3—Diagram of Moderator System

Improved V-Notch Weir Recorder

A FEATURE of the improved V-notch weir recorder recently introduced by the Cochrane Corporation, Philadelphia, Pa., is the use of a simple cam as a rectifying mechanism, to give uniform graduation on the recording chart, and indicating scale.

Referring to Fig. 2, the cam is hung from pivot bearings and oscillates in a vertical plane, while a roller carried by the float stem and moving up and down in a straight line bears against the edge of the cam, approaching the axis or center of oscillation of the latter at the higher flows.

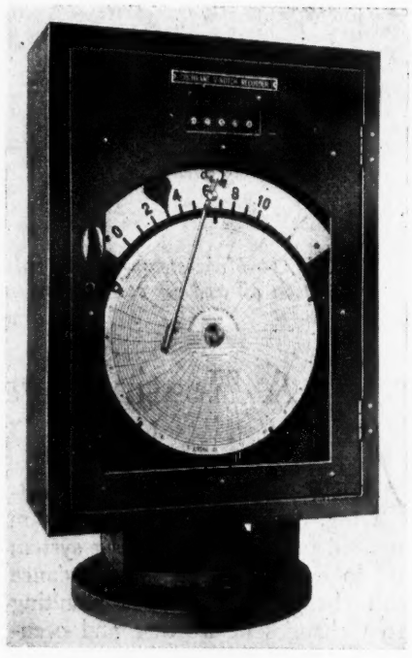


Fig. 1—Indicating and recording meter

With this construction a cam of comparatively simple form can be used, for as the roller approaches the center of oscillation its effect in moving the cam angularly is increased just what is required to accommodate the 5/2 power law for the flow over a V-notch. A counterweight on the cam keeps the latter always in contact with the roller.

The pen arm is attached directly to the cam spindle, while the indicating pointer is mounted on a separate spindle connected to the cam by a link motion. The operation of the integrator is controlled by motion received through a pair of toothed sectors. The positive, direct drive from the float to the recorder pen

eliminates lost motion, and rapid up and down movements of the float cannot put the instrument out of order.

The integrator is of the clock-driven type and imposes no restraint upon the flow-measuring parts. The gear train consists of spur gears, each pair having a ratio of 10 to 1. There is only one tooth on the pinion

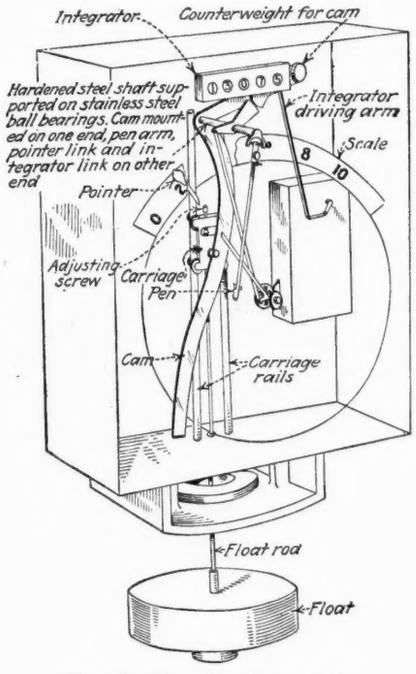


Fig. 2—Detail of operating mechanism

and ten teeth on the gear. The one tooth on the pinion engages for only a part of the revolution, the gear being held stationary during the remainder of the pinion revolution. With this mechanism two adjacent teeth of the gear, except the first or highest-speed gear, advance a whole number at a time and do not give a gradual, continuous movement of the figures, as would be the case were an ordinary gear train used.

The first, or highest-speed, gear is advanced by varying small increments which are proportional to the momentary rate of flow. A rod attached to a crank rotated by the clock operates a clutch which engages with the milled edge of a disk mounted on the spindle of the first counter-train pinion. Each stroke of the clock pulls the clutch back to the starting point, where it engages with the milled disk, and then pushes it forward until the clutch is thrown out of engagement by a cam. The position of this cam is determined by the position of the main cam, and therefore by the rate of flow, the transmission of motion from one cam to the other being by a pair of toothed sectors. It will be seen that the counting train is thus advanced for each interval of time by an amount proportional to the instantaneous rate of flow, and that the result for a longer period of time is totalized or integrated flow.

Only one clock is required, and this may be of the double-spring type or an electric clock may be used where alternating current of controlled frequency is available.

Desuperheater Governor

WITH a view to providing a positive and automatic means of controlling the amount of water supplied to a desuperheater, or, in other words, the temperature of the steam leaving the desuperheater, the Swartwout company, 18511 Euclid Ave., Cleveland, Ohio, has introduced the desuperheater governor illustrated.

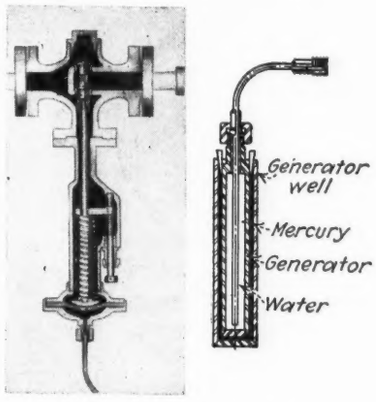


Fig. 1—Cross-section of governor valve and governor generator

The details of the governing valve and the generator which produces the pressure to operate the valve are shown in Fig. 1, and a typical installation in Fig. 2.

The governing valve is inserted in the water line leading to the desuperheater, and the generator in the steam line leaving the desuperheater. The generator well, the connecting tube and the space below the diaphragm of the governing valve are full of water, consequently with the steam passing around the generator well, the water in the well becomes heated to approximately the temperature of the steam and thus the vapor pressure exerted on the diaphragm of the control valve is in direct relation to the temperature of the steam passing through the pipe.

In operation, if the steam leaving the desuperheater is saturated, the pressure on the diaphragm of the governor will be equalized and the tension of the spring above the diaphragm will hold it closed. But if the temperature of the steam rises, a greater pressure will be created by the water and the valve will be pushed open and water admitted to the desuperheater. Adjustment of the governor to give the desired steam temperature is readily made by changing the tension of the spring in the valve bonnet.

The generator well (see Fig. 1) is made to be welded directly into a pipe line or screwed into a flange, as shown in Fig. 2. The water chamber of the generator is made slightly smaller in diameter than the bore of the well, and the intervening space is filled with mercury to insure good heat transfer. The governor is made in pipe sizes from ½ to 3 inches.

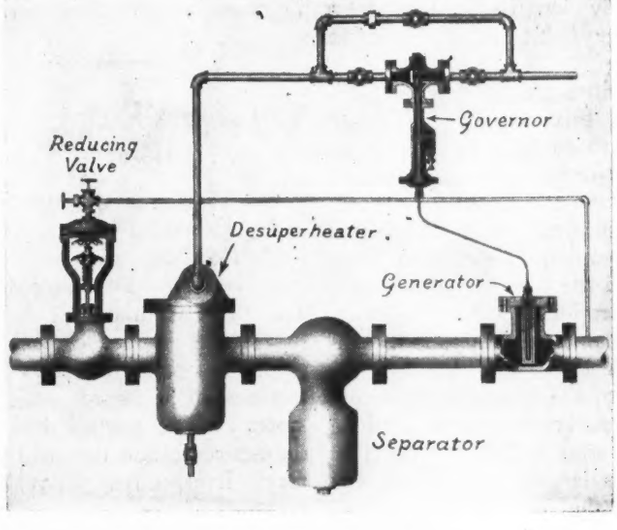
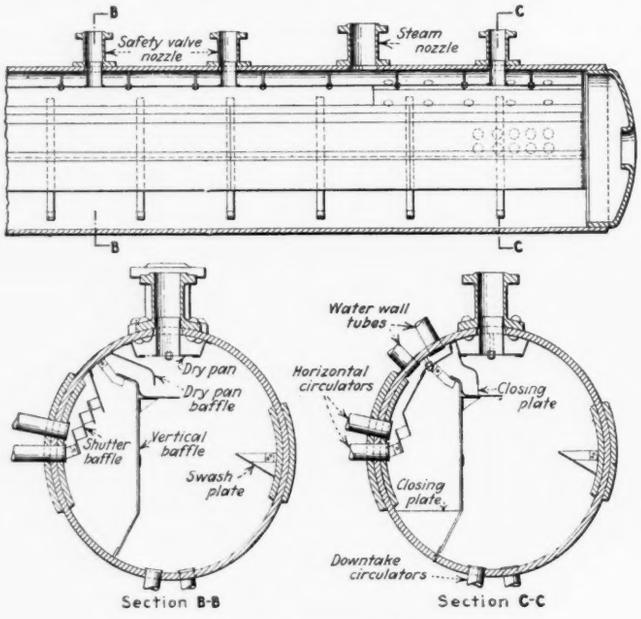


Fig. 2—Typical installation of desuperheater governor

Improved Cross-Drum Boiler Steam Baffles

WITH cross-drum boilers operating at capacities up to 150,000 lb. of steam an hour, satisfactory moisture conditions are obtained with a vertical baffle plate placed somewhat back and away from the steam discharge tubes or circulators. With this construction steam and water coming into the drum from the circulators are separated underneath the baffle and in the travel lengthwise the drum under the baffle, and again partly lengthwise the drum outside the baffle in the reverse direction.



Longitudinal and cross-sections of drum, showing baffle arrangement

As capacities are increased materially above this output, the steam velocities are so high as to prevent proper separation of the entrained moisture from the steam. To overcome this difficulty the Babcock & Wilcox Company, New York City, has adopted the type of baffle shown in the illustration.

The fundamental change is to substitute transverse flow for longitudinal flow of the steam in the drum. Over the steam circulators is installed a set of shutter baffles, the function of which is largely to dissipate the velocity of the incoming steam and water and to separate the larger percentage of the water from the steam. Outside of the shutter baffles is a typical vertical baffle with an inclined top portion, and above this an inclined baffle plate forming a channel-way for the steam flow. Above this latter baffle is a box-type drypan replacing the old-type drypipe. In the case of high capacities such as 400,000 or 500,000 lb. an hour, considerable more headroom is obtained in the drum by using this type of construction over the old-style round drypipe.

This baffling has been adopted as standard on cross-drum boilers made by this company — having capacities in excess of 150,000 lb. an hour.

Improved Electric Control for Heating System

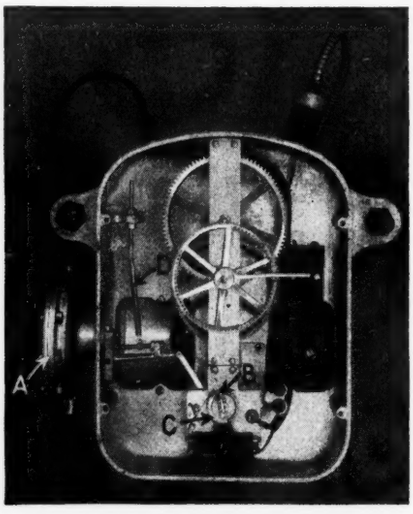
On page 528 of the March 20, 1928, issue of *Power* there was described an electric control for heating systems. The purpose of this equipment is to permit the engineer to regulate from a central point the amount of steam supplied to various sections of a zoned orifice heating system. The control will maintain the desired steam flow to the various zones irrespective of variations in pressure of the steam supply.

Several new features have been added to this control, which is manufactured by Webster Talmadge & Company, Inc., 50 Church St., New York City. A linkage motion has been inserted between the pressure diaphragm *A* and the cam follower *B*, so that the effect of angularity compensates for the shape of the pressure-flow curve. Thus equal movements of the cam *C* will result in equal increments of steam flow to the zone under control. Since the cam takes position similar to the handle on the control board, equal movements of it will give equal increments of flow. Thus from the position of the control handle the operator can visualize the proportional amount of steam going to any zone.

The installation of the linkage mechanism made possible a change in the method of securing a zero setting. The tension in the spring *D* is adjusted until it holds the diaphragm $\frac{1}{32}$ in. from its stop, exactly balancing the static head of water existing in the tubing between the control and the steam pipe, when there is no pressure and no steam flow in the system.

This setting places the diaphragm in a floating position so that it is sensitive to low pressures. The combined effect of these changes has been to improve the steam regulation at light loads, under which condition the greatest savings are to be obtained.

The motor driving the valve-operating mechanism has been changed to a universal, series-wound, split-field motor, and a governing arrangement to hold constant speed. With this combination it is possible to set the governor to maintain almost any desired constant speed. The speed is usually adjusted so that the steam valve will completely open or close in fifteen minutes.

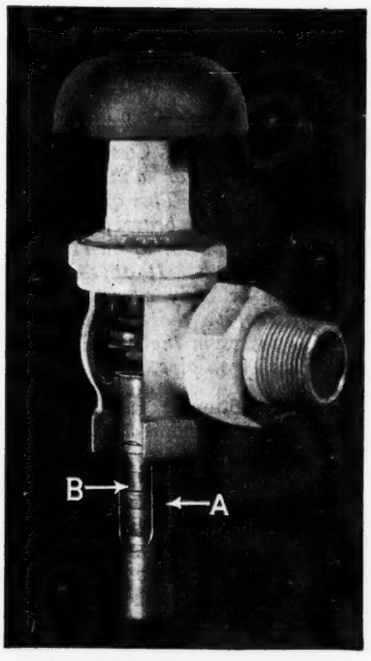


Electrically controlled valve, operating mechanism

Equiflo Radiator Valve for Forced Hot Water Heating Systems

THE Equiflo valve illustrated is designed to give a simple method of equalizing the frictional resistance in the piping to each radiator of a forced-circulation hot-water heating system and thus give a balanced circulation at all temperatures of water.

The valve is a standard type radiator valve fitted with a tube *A* in which are inserted a series of orifices and baffles as shown in the cut-away section of the tube *B*. The orifices and baffles serve to give the proper



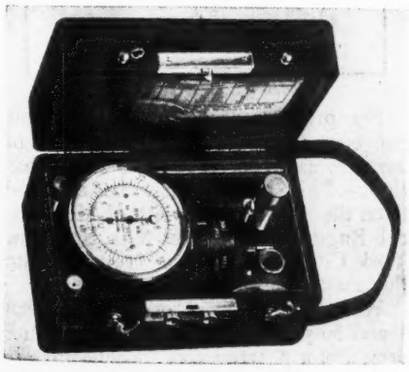
Flow through radiator is regulated by means of orifices and baffles in valve discharge

frictional resistance to the flow with an open valve and independently of the size of pipe leading to the radiator. The flange of the tube *A* containing the orifices and baffles rests on the seat of the valve and acts as a gasket. The tube is extruded into the valve seat to hold it tightly in position. The orifices are of large size so that there is slight chance of clogging by particles of scale or other foreign matter.

It is pointed out by the manufacturer, the Grinnell Company, 260 West Exchange St., Providence, R. I., that the required orifices and baffles for each radiator are determined by its engineers from the contractor's plans and that after the system is completed the tube is readily inserted into place by removing the valve bonnet and dropping it into place.

Improved Hand Tachometer with Rotating Gear Shift

IN THE improved tachometer illustrated, recently introduced by O. Zernickow Company, 15 Park Row, New York City, the over-all



Hand tachometer for speeds from 20 to 40,000 r.p.m.

length of the instrument has been reduced and a rotating gear shift has been substituted for the sliding gear shift formerly used in the tachometers made by this company.

The instrument, which is of the single-spindle, triple, quadruple and quintuple selective range type is designed to be accurate within one-half of one per cent and suitable for speeds from 20 to 40,000 r.p.m. The spindles are of steel hardened and ground, with ball and bronze bearings throughout. The shifting of the gears to obtain the proper speed ratio is done by turning the tachometer barrel until the desired range lettered on the barrel is in line with the dial center, where it automatically locks into position.

The tachometer is furnished with a carrying case, as illustrated, and the complete outfit includes a steel point for measuring speeds up to 200 r.p.m. a rubber point for speeds above 200 r.p.m., a funnel center for small shafts, a rubber sleeve for special applications, an extension bar 3 in. long for use where the center of the shaft is located inside of the machine and a rubber-bound cut-meter wheel for cutting or belt speeds.

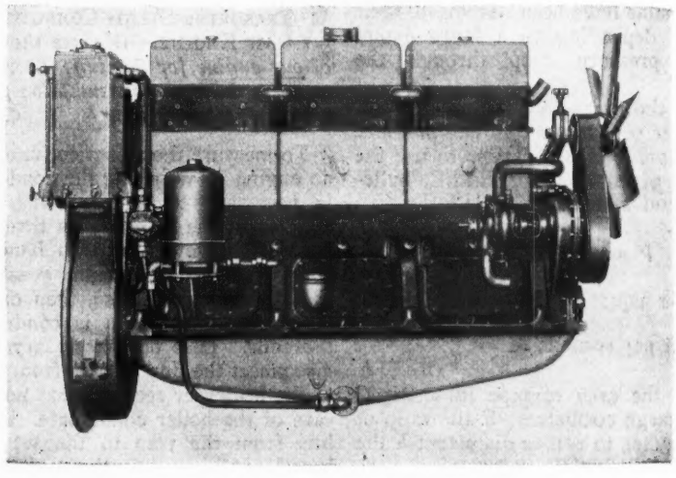
Another claim made for the instrument is that it is unaffected by outside influences such as magnetism, changes of temperature and moisture. The weight of the instrument is 12 ounces.

Six-Cylinder Light-Weight High-Speed Diesel

A HIGH-SPEED light-weight full Diesel engine especially suitable for driving electric generating units, locomotives, compressors and similar equipment, is announced by the Buda Company, of Harvey, Ill.

The engine is a six-cylinder ($6\frac{1}{2}$ x $8\frac{3}{4}$ in.) designed to run at 1,000 r.p.m. and develop 180 hp. The over-all length is 89 in., the height is 58 in. and the weight without clutch approximately 5,400 lb.

The engine is of the airless fuel injection type, and compressed air is not used either for starting or running. The unit is started by means of a small two-cylinder gasoline engine mounted on a bracket which is cast on the flywheel housing. The engine is fully equipped with fuel oil, lubricating oil and air filters, and fuel having a Baumé gravity of 26 to 38 can be used.



Six-cylinder Buda engine

FROM AMONG THE READERS' PROBLEMS

Conducted
By
L. H. Morrison

Moving Coke Breeze.—*In one plant a large amount of coke dust must be moved about 200 ft. to the boiler plant. What is the cheapest method to use?* T.B.C.

A pneumatic system, consisting of a suction fan, piping and a receiving bin, will probably work out as the cheapest to install.

Sizes of Anthracite.—*What are the dimensions of the various grades of anthracite coal on the market?* K. E. V.

The various grades of anthracite are classified on the basis of the round-opening mesh screen they will and will not pass through, as shown in the table.

Coal Grade	Mesh Passing the Coal, In.	Mesh Not Passing the Coal
No. 1 Buckwheat	$\frac{5}{16}$	$\frac{3}{8}$
No. 2 Buckwheat (rice)	$\frac{3}{16}$	$\frac{5}{16}$
No. 3 Buckwheat (barley)	$\frac{3}{16}$	$\frac{3}{16}$
No. 4 Buckwheat (birdseye)	$\frac{3}{32}$	$\frac{3}{16}$
Pea	$\frac{3}{4}$	$\frac{7}{8}$
Nut	$1\frac{1}{2}$	$\frac{3}{4}$
Stove	$2\frac{3}{8}$	$1\frac{1}{2}$
Egg	$3\frac{1}{4}$	$2\frac{1}{4}$
Broken	$4\frac{3}{4}$	$3\frac{1}{4}$

Calculating Air Flow.—*What is the proper method of calculating air flow by the use of an orifice?* F. S. D.

The theoretical equation for the flow of air through an orifice is very complicated, and it is desirable to avoid its use whenever possible. Various simplified formulas have been developed, their accuracy depending to a large extent on the pressure drop through the orifice.

When the pressure differential is not over 1 per cent of the absolute pressure in the pipe, it is permissible to use the equation given in the A.S.M.E. bulletin on fluid meters, which is

$$V = CM\sqrt{2gh\,\frac{d}{d_i}}$$

In this equation V equals flow in cubic feet per second; $M = \frac{A}{\sqrt{R^4 - 1}}$, A being the area of pipe in sq.ft.; C the discharge coefficient; R the ratio of pipe diameter to orifice diameter; h the pressure differential in feet of a gage liquid whose density is d; and d_i the density of the air metered.

The value of the coefficient C varies with the location of the pressure tap and with the value of R. When the upstream tap is one pipe diameter above the orifice and the downstream tap is located at the vena contracta (between 0.5 and 1 diameter from the orifice) the value of C when R is 2, is 0.63; when R is 4, C equals 0.60.

For pressure drops greater than one per cent the bulletin gives a table of corrections to be applied to this equation. This bulletin may be obtained from the American Society of Mechanical Engineers, 29 West 39th St., New York City, should you desire to go into this matter in greater detail.

When the pressure drop is between 1 and 50 per cent of the initial absolute pressure, a nearly exact formula for air given by S. A. Moss, of the General Electric Company, can be used. This formula, giving volume in cubic feet per minute is:

$$V = \frac{19.231\ D^2CT_2}{P_2} \times \sqrt{\frac{P_1 - P_2}{T_1}\ [P_2 - 0.0755\ (P_1 - P_2)]}$$

In this equation D equals orifice diameter in inches; C is a coefficient; T_2 and P_2 the absolute temperature in deg. F. and the pressure in pounds per square inch at which the volume is desired; P_1 and T_1 are the initial temperature and pressure, and P_2 is the final pressure in pounds per square inch. The same values for C may be taken as used in the A.S.M.E. formula.

Measuring Steam Consumption of an Engine.—*We use the exhaust of our engine for heating; how can we measure the steam consumption per indicated horsepower hour?* C. S. A.

To measure the steam consumption of an engine by weighing the condensate it is necessary to be sure that all the exhaust of the engine goes through the coils from which the trap handles the condensate. If no steam goes out of the atmospheric release, then of course all the exhaust steam is condensed in the coils. It is only necessary then to disconnect the line leading from the trap to the heater or receiver that now takes care of the boiler condensate. Run this line from the trap to the set of two barrels and arrange these so that the condensate fills the barrels to a predetermined level, at which time the discard line is passed into the second barrel and the first barrel is emptied into the receiver or condensate tank. Counting the number of barrelfuls that have been handled in one hour and then weighing one barrel, one can arrive at the total weight of steam that is handled per hour.

Now to find the indicated horsepower of the engine, it would be necessary to obtain an indicator diagram from the engine. If interested in the steam consumption per brake horsepower and if the engine is driving a generator, by taking the amperes and voltage in case the machine is direct current the total kilowatt-hour output can be found. If the kilowatt-hour output is divided by 746, the electrical horsepower that the generators put out is obtained. Assuming, then, about 90 per cent efficiency, divide this electrical horsepower by 90 per cent, which will give the horsepower delivered to the generator.

Brass Pipe Used as Conduit.—*Does brass, copper or aluminum have magnetic qualities? This question came up regarding using brass pipe as conduit for each conductor of an 11,000-volt three-phase circuit. It appears to me there would be eddy currents induced in the brass pipe that would increase the power losses in the line, but not as much as with iron pipe.* E. M.

Your assumptions regarding the use of brass pipe as conduit are correct. It acts about the same as a lead covering on the individual conductors of the three-phase circuit. Unless the conductors are properly arranged, there is likely to be excessive heating of the conduit. The best arrangement is to place the three legs of the circuit in an equilateral triangle. If this cannot be done, then the conduits placed in the same plane will suffice. The cables in the conduits should be arranged so that each group of three includes an *A*-, a *B*- and a *C*-phase conductor. If parallel circuits are used, this relation should be maintained. Do not pull like phase conductors into adjacent conduits. The magnetic properties of brass, copper and aluminum are practically the same as those of air.

A Question For Our Readers

SINCE high-pressure steam in a soot blower may cause tube cutting, at what pressure is one justified in installing a reducing valve?

P. Q. R.

Suitable answers from readers will be paid for and published in the Feb. 12 issue

Development of
LAPPED PIPE JOINTS

Historically and Technically Considered

This article is an abstract of a paper presented by A. M. Hauser, Product Engineering Department, Crane Company, Chicago, Ill., before the Engineering Institute of Canada at Montreal on October 18, 1928.

IN THE earlier days of steam engineering, when 125 lb. per sq.in. was considered a relatively high pressure, the screwed or threaded pipe joint was in common use and was considered safe and reliable for any pressure range then carried on the boilers. Originally, the screwed flange was a flat ring threaded to fit the threaded pipe and provided with drilled holes for bolts; later, the hub was added to the flange for strength.

Originally, the screwed joint differed from that shown in Fig. 1 in that full-face gaskets were used, extending from the inside edge of the pipe to the outside edge of the flange, covering the entire area of the face of the flange and end of pipe except for the bolt holes. This practice, according to records, seems to have evolved from old-time marine work. During the early 90's, when higher pressures were considered, it was thought wise to reduce the gasket area. At that time it was felt that with higher pressures the resultant load per square inch of the full-face gasket would be small; and that a slight transverse stress produced by expanding pipes would open the joint on one side, thereby causing a leaky joint. The tongue-and-groove joint was introduced at this time. The groove has the merit of protecting the gasket from misplacement or being forced out in part by the pressure of the bolts; the gasket is also protected from being blown out if slightly relieved on one side.

The one-sixteenth inch raised face, which is common practice today, also has its history. The raised face as made today has its diameter just inside of the bolt holes and is raised one-sixteenth inch above the remainder of the face of the flange; one-quarter inch raised face is used on higher-pressure and flanges to take care of interchangeability with male and female face. About 1898 and 1899 the raised face was a live subject among leaders in steam engineering, but the tongue and groove was in practice for some time before the raised face was considered. The flat-face joint with full gasket was the most popular joint in those days.

Some joint faces were made about three-sixteenths of an inch wide, and by making the flange heavy enough to be real stiff, the bolt pressure would come on the joint and not at the outer edge of the flange. The raised face came into common practice about 1904 to overcome the use of these excessively heavy flanges and to insure a tight joint. To take care of the pressures of the time the raised face was introduced in the form of a "narrow chipping strip" as wide as thought necessary for all pipes, and the joint was so designed that the surfaces in contact were inside the bolt circle. One thirty-second inch raised face became regular practice, being used almost exclusively until the adoption of the 1914 standards for flanges, when the one-sixteenth inch raised face became standardized.

With the advent of larger central stations and the increasing demand for superheated steam at higher pressures, manufacturers were called upon to furnish pipe joints that would insure a higher all-around factor of safety than was previously possible with the

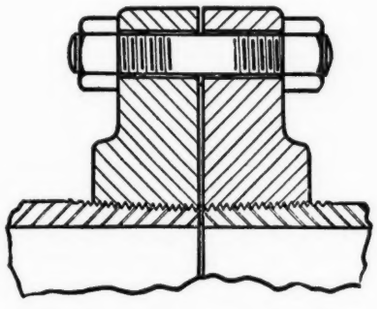


Fig. 1—Typical screwed joint with hubbed flange

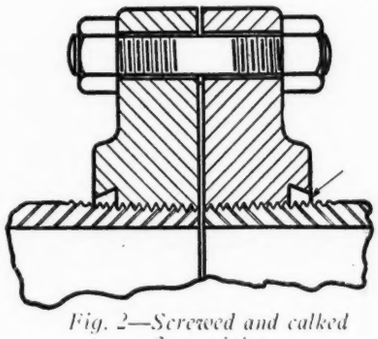


Fig. 2—Screwed and calked flange joint

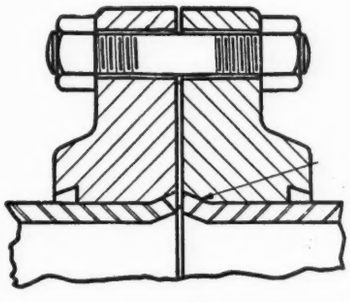


Fig. 3—Shrunk and peened joint

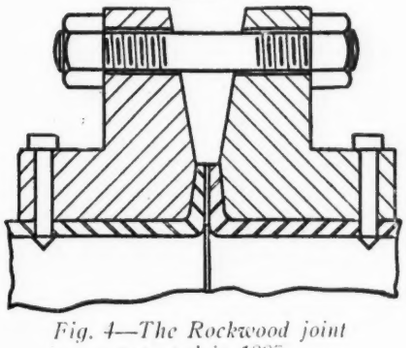


Fig. 4—The Rockwood joint patented in 1897

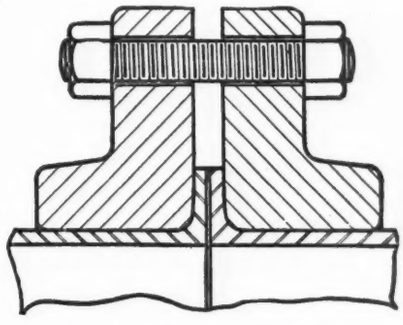


Fig. 5—Plain-face square-cornered joint

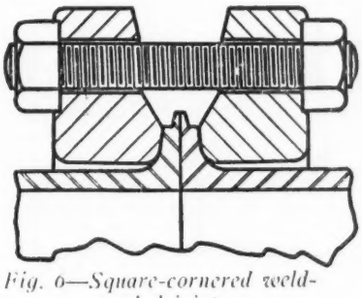


Fig. 6—Square-cornered weld-sealed joint

screwed joint. The trouble experienced with screwed joints might be traced to the fact that when the pipe, which is screwed into the flange, expands circumferentially, it tends to return again to its original dimensions when cooled; but the flange in time, owing to other strains, takes a permanent set and does not return again to its original dimensions, increasing slowly the inside diameter. However slight, this space between the threads on the pipe and the threads on the flange will permit slight leakage which is increased as time goes on by the oxidizing and erosive action of the steam and water.

Several novel methods have been devised to guard against this leakage through the threads in an effort to make good the screwed joint for the increasing higher pressures. Favorable results for that time were obtained by cutting a calking recess in the hub of the flange. This type, as illustrated in Fig. 2, has stood the test of time quite well. The pipe is screwed into the flange to a steam-tight bearing, and the recess is then filled with soft copper or other suitable metal, which is calked firmly in place.

A step nearer the Van Stone joint was made when the shrunk and peened joint was first used. In making this type of joint, the flange is accurately bored out to a diameter slightly less than the outside diameter of the pipe. When heated to a proper temperature, the flange expands and is forced over the end of the pipe. In cooling, the flange contracts and grips the pipe all around its outside circumference with tremendous force. The end of the pipe is allowed to project slightly beyond the face of the flange and is peened over into the recess. If so desired, a calking recess can be provided, and if a slight leak occurs the recess can be calked with soft copper. Fig. 3 shows this form of joint.

The Rockwood pipe joint was patented in the United States April 6, 1897. The joint, shown in Fig. 4, as patented differs slightly from the original idea in that a bead is formed in the pipe, fitting a groove in the flange instead of the rivets. This was used to prevent longitudinal movement of the flanges in the process of making the joint.

The Rockwood joint, minus the bead or rivets, is the Van Stone joint of today.

The square-cornered joint is made by rolling the joint to a square-cornered surface at the inside edge of the lap, giving wider bearing surface for the gasket and at the same time eliminating a water pocket at the joint. The elimination of this pocket, which is always present with round-cornered joints, means more even and uniform expansion and contraction throughout the joint. Corrosion is more likely to set in with the round-cornered joint, due to lodging of sediment and condensate, which is present in all lines.

The differences between the Van Stone and square-cornered joints can be seen from Fig. 5.

This square-cornered joint was first introduced in 1911 and can be used successfully on the present-day high pressures. The plain straight face is in reality a raised-face joint. The diameter of the lapped-over pipe was not standard until 1920; when it was suggested to use the diameter of the raised face as given for flanges approved by the American Engineering Standards Committee. Today this is regular practice.

Weld-sealed pipe joints without the interposed gasket have been used in many of the high-pressure, high-temperature central stations. Practically all the weld-sealed joints were made under the Sargol patent license until its recent expiration.

Welding lips on the Sargol joint are formed by machining the adjoining edges of the laps to a V-shape, into which additional metal is welded to form a seal. The back face of the lap is not machined in order to keep the "skin tension" of the material. A slight clearance is maintained between the outside diameter of the pipe and the inside diameter of the flange to permit swiveling of the flange to line up the bolt holes when the pipe line is being erected.

In welding the Sargol joint a filler rod is necessary to fill the V-shape gap. The welding requires a large amount of heating; this intense heat concentrated at the extremities of the lap causes uneven expansion and contraction, thereby separating the flanges around their inner circumferences.

In order to overcome this difficulty a thin-lip, weld-sealed pipe joint was introduced about two years ago, as illustrated in Fig. 6. No additional metal is required for welding, as the long thin lips are simply fused together. This seal is very narrow and thin, requiring little heat in the welding operation. These weld-sealed joints are usually tested under the full operating pressure before welding, the joint being metal to metal.

Recent Publications

The New Way to Net Profits. By Fred W. Shibley, vice-president, Bankers Trust Company, New York City. Published by Harper & Brothers, 49 East 33d St., New York City. 206 pp. Price, $3.

THIS latest book on the science of business is a practical treatise dealing with the making of net profits in business and industry. As a result of the financial crisis succeeding the short period of industrial activity immediately following the World War, Mr. Shibley, who for many years had been a student of industrial management, found himself faced by many problems involved in his studies of making American business pay its way. In his close, practical association with the reorganization and reconstruction of a number of businesses subsequent to the period of business adjustment in 1920 and 1921, it became apparent to him and others working with him along the same lines that if net profits were to result, old methods of production must be reversed and manufacturing output must be controlled by the amount of output which could be sold by any one company. Mr. Shibley's book describes the system of forecasting sales which was devised to accomplish this purpose, and the plant operated in connection with such a forecast.

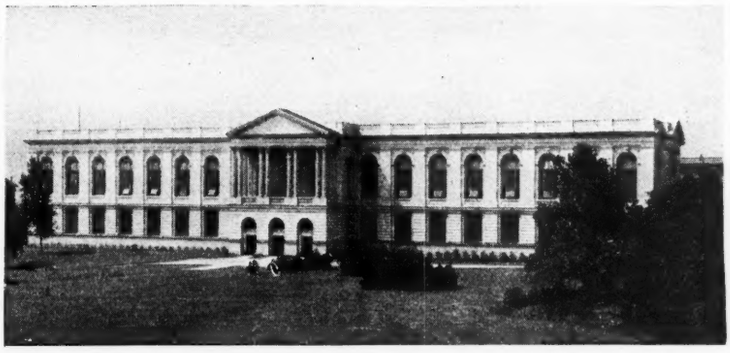
The book opens with a chapter on "Why the New Way Was Found Necessary," in which the fact is established that today is the day of the thinker, the philosopher in industry. Modern business has become highly complex and must be conducted on scientific principles. In consequence the business man today must possess the intellectual qualifications and the practical wisdom of a philosopher if he expects to attain pre-eminence. The "New Way" is then discussed in detail as pertaining to market study, merchandising, distribution, sales forecast, production, planning, budgeting control, management, research and analysis. The underlying theme of the whole book is "success in business," but for success the business man must co-operate with his fellow men in business in order that there shall be co-ordination of thought and effort in the business of the nation. The individual business man will be most successful when the greatest number of his fellow men are successful.

Principles of Scientific Purchasing. By Norman F. Harriman, Published by McGraw-Hill Book Company as part of "Industrial Management Series," of which Dean Dexter S. Kimball is consulting editor. Cloth; 6x9 in.; 301 pages. Price, $3.

NO BOOK can substitute for actual experience, but in this age of evolution in business practice, industry imposes new responsibilities on the purchaser, and experience alone is often insufficient. This book provides a useful supplement to purchasing experience, and a perusal of its pages will enable the purchasing agent to check up on his methods to see that he has not omitted any important factors. Furthermore, it will aid him in weighing the relative importance of these factors that pertain to his particular problems. The chapters on the economic, financial and psychological aspects of purchasing are especially instructive, and that on legal aspects provides a useful guide that should save the purchaser from many unnecessary embarrassments.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE



Philadelphia Commercial Museum

First Heating and Ventilating Exposition To Be Held in January, 1930

Philadelphia Chosen for Show—Many Exhibitors' Applications Already Received

THE First International Heating and Ventilating Exposition will be held at the Commercial Museum, Philadelphia, Pa., Jan., 27-31, 1930. This show is scheduled for the same week as the 36th Annual Meeting of the American Society of Heating and Ventilating Engineers, and present indications point to the most extensive assembly of heating and ventilating equipment ever seen under one roof.

For years there has been need of a place for manufacturers to display their products, so that heating and ventilating engineers, contractors and others interested might have an opportunity to see the progress made in providing equipment that would bring greater comfort and efficiency to the home dweller, the office and factory worker, or the inmate of any institution.

The Council of the American Society of Heating and Ventilating Engineers endorses this exposition after a thorough investigation by a special committee, the personnel of which included: H. P. Gant, chairman, Philadelphia, Pa.; W. H. Carrier, Newark, N. J.; Roswell Farnham, Buffalo, N. Y.; C. V. Haynes, Philadelphia, Pa.; and J. F. McIntire, Detroit, Mich. This committee reported favorably to the Council and recommended that the exposition be opened Monday morning, Jan. 27, and close Friday night, Jan. 31, under the direction of the International Exposition Company, which has handled such important industrial expositions as the Chemical Show, the Power Show and the Hotel Men's Exposition.

The co-operation of organizations interested in the heating and ventilating and allied fields has been invited by the society, and an Advisory Committee of representative men have expressed their willingness to assist in making this First Heating and Ventilating Exposition a success.

The response to the first announcement of the show has been large, the number of applicants for space having already reached a total of more than 35 manufacturers. The exhibition hall will contain 673 booths, all of them arranged for electrical, water and gas connections. Admission to the exposition will be by registration, and no admision fee will be charged.

U. S. and Canada Sign Niagara Pact

Agreement between the United States and Canada to protect the scenic beauty and economic value of Niagara Falls from further degeneration has been completed in Ottawa. William Phillips, American Minister at Ottawa, and Mackenzie King, Prime Minister of Canada, signed a convention providing for the construction of remedial works in the Niagara River above the falls which competent engineers have declared will preserve and perhaps improve the beauty of both the falls and the rapids.

Announcement of the signing of the convention has just been made at the Department of State. It was accompanied by a brief explanation that the proposed remedial works follow closely recommendations made by the special International Niagara Falls Board, composed of prominent American and Canadian engineers, created by the two governments in 1926 to make a close study of what steps should be taken jointly by the United States and Canada to preserve the falls

At the same time the convention was signed the American Minister and Canadian Prime Minister also signed a protocol prescribing in detail how the work is to be done. In addition to the proposed protective works the convention authorizes a temporary diversion of an additional amount of water on each side of the boundary not to exceed 20,000 sec.-ft. for the purpose of determining the efficiency of the remedial works to accomplish the purposes for which they are to be constructed.

Construction of protective works recommended by the international board of engineers will cost the United States and Canada together in the neighborhood of $1,750,000. After the works have been completed, there probably will be a nominal maintenance cost, which would be assessed more or less equally upon each country.

Congress, of course, must pass on the entire project before it is put into operation. There are no funds now available to begin the work and an appropriation must be voted. In addition, the terms of the convention undoubtedly will be carefully examined by the Senate before they are approved. Because of the tremendous value of Niagara Falls, both as a scenic wonder and as a source of tremendous quantities of hydro-electric power, little opposition to the plan is expected in Washington.

The remedial work proposed by the International Board consists of a combination of excavations and submerged wires carried from the shores near the flanks of the Falls into the adjacent main currents far enough to deflect water to these parts of the Falls which in the course of years, due to the natural wearing away of the face of the Falls and to the diversion of water for power and sanitary purposes, have become bare. These works would be submerged and would not injure the natural beauty of the spot by giving it a man-made appearance.

WILLIAM S. MONROE, president of Sargent & Lundy, Inc., of Chicago, has been appointed to membership on the A.S.M.E. Standardization Committee for the term 1928-33. Mr. Monroe will take the place of A. M. Houser, whose term of membership expired this year.

Spot * News

JACKSONVILLE, FLA., *has just started up a 25,000-kw. turbine in its municipal light plant. This is a record breaker for Florida municipal plants.*

* * *

THE MONTANA POWER COMPANY *has let the contract for the construction of a 70,000-hp. hydro plant to be built on the Missouri River north of Great Falls. The cost will be $4,000,000 and the completion date January, 1930.*

* * *

ONE DOLLAR *is the price for which the city fathers of Atlanta, Nebraska, have agreed to sell their municipal electric light plant to the local public utility company. The other side of the bargain includes 24-hour electric service to replace the 12-hour service given under the old arrangement.*

* * *

TWENTY-ONE THOUSAND *phone calls a day come through the Brooklyn Edison's private branch exchange, it is estimated. A comfortable majority of these calls are presumably from customers asking for emergency service of one kind or another.*

* * *

THREE PLANTS, *projected for the Holston River in Tennessee, would aggregate 74,000 hp. Part of this energy would be used for public utility purposes, while the remainder would serve to supply new industries drawn into the district, which is now undeveloped.*

* * *

THE CANADIAN GOVERNMENT, *through its water power branch, has issued a report showing that 28 per cent of the total hydro power in the Dominion is consumed by the paper and pulp industry. The total horsepower in that industry aggregates 565,362 hp., says the report.*

* * *

SUCCUMBING *to modernization after 36 years of steady service, a direct-current motor in a Brooklyn wood-working shop lately gave place to an up-to-date machine. The veteran had been in service at the same address since 1893.*

* * *

THE NUMBER OF APPLICATIONS *received by the Federal Power Commission during December last, had not been exceeded in any month since January, 1923. Most of the applications, however, were for projects of small size.*

* * *

THE POWER COMMISSION *is still hearing arguments for and against the private development of Cumberland Falls in Kentucky. The bone of contention is the question whether the power interests will destroy the falls, as some nature lovers claim, or will actually enhance their beauty by equalizing the flow, which is at present exceedingly variable.*

Welding for Power and Piping Is Subject of New York Meeting

"The Present and Future of Welding in Power Plants" and "Training and Management of Welding Operators for Pressure Piping, Tanks and Vessels" were the parallel subjects of two papers presented Jan. 8 at a joint meeting of the Metropolitan Sections of the A.S.M.E. and the American Welding Society. The review of power-plant welding took the form of more than sixty lantern slides presented by P. W. Swain, managing editor of *Power*. Welding applications shown included piping and headers of all types for steam, Diesel and refrigerating plants; repair and maintenance of crankshafts, frames, gears, pistons and worn shafts; application of wear-resisting materials; pressure vessels; surface condensers; machinery bases; motors; generators; zeolite water softeners; evaporators; extraction heaters; transformer tanks; blowers; economizers; breechings; air heaters; steel framework of power plants; pulverized-coal collectors. Many of the pictures shown will be reproduced in an early issue of *Power*.

The paper on the training and management of welding operators, prepared by H. H. Moss and delivered by G. O. Carter, both of the Linde Air Products Company, showed that the problem of specifying and insuring sound welding is not essentially different from that for other engineering work. The executive without specialized knowledge of welding can have welding specifications drawn up so as to check each step in welded construction and place the responsibility for trouble where it belongs, should the final test not be met. This, Mr. Moss' paper pointed out, is exactly what he does with other methods of fabrication where he calls for certain results to be proved by test. He doesn't worry about correct practices because he provides inspection to see that specifications are carried out. An extensive abstract of Mr. Moss' paper will appear in an early issue of *Power*.

In the discussion R. G. S. Pigott expressed the hope that welding would be permitted for boiler construction in the not distant future. This, he said, would eliminate much trouble now experienced with rivets.

In The News

The Tokyo Engineering Congress, mentioned in the next column, will be devoted to a study of power resources throughout the world. The new spirit of internationalism which has underlain the World Engineering Conferences since 1924, is one which should command the attention and interest of every engineer whether he expects to go to Japan this fall or not.

Delegates to Tokyo Congress to Sail October 11

Formation of 90 local committees, organized to aid in recruiting a large delegation of American engineers to attend the forthcoming World Engineering Congress at Tokyo, was announced recently by Dr. Elmer A. Sperry, chairman of the American committee arranging participation in the event. The local committees represent every section of the United States, Panama, Mexico and Canada where there are engineering activities, and include engineers of every branch.

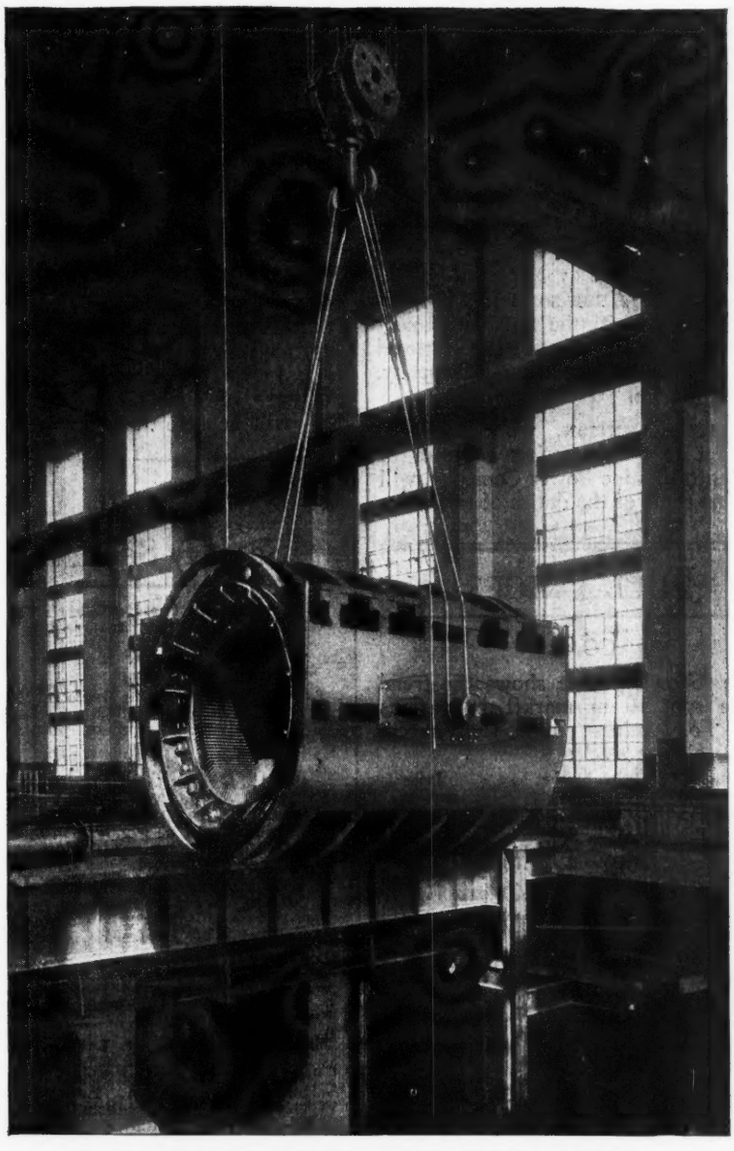
The 90 committees will work with the various subcommittees of the American committee to maintain interest between now and Oct. 29, the opening date of the congress. The committee on promotion and attendance, headed by George W. Fuller, of New York, has procured 2,000 ft. of new motion picture film from Japan, which is being recaptioned and arranged in sequences to show points of interest for engineers. This film will soon be released for distribution to the co-operating committees.

Through Maurice Holland, executive secretary of the American committee, it is announced that the "President Jackson" of the Dollar Line has been reserved exclusively for this country's delegation and will sail from San Francisco on Oct. 11. Mr. Holland further says that applications have already been received for reservations on the official ship totaling 150, and he urges engineers to forward their applications at an early date to the American Express Company, the official transportation agent.

Columbia River Project

That the time is approaching when it will be feasible to bring in some of the less costly potential water powers of the Columbia River, is indicated by the attention sites on that river are attracting. The Washington Electric Company, of Seattle, a Stone & Webster concern, has just applied to the Federal Power Commission for a preliminary permit covering an important site twelve miles below Wenatchee, Wash., in the west channel of the Columbia near the lower end of Rock Island. The ultimate installation will be 144,000 kilowatts.

Development of the Columbia was suspended for some time pending a study of the proposed Columbia Basin irrigation project. The Department of the Interior finally came to the conclusion that several decades probably must pass before the project would be undertaken.



A FIFTY-FIVE THOUSAND KW. GENERATOR Stator, on its way to its foundations in the new Delray No. 3 plant of the Detroit Edison Company

In addition to the proposed Stone & Webster project Hugh L. Cooper is planning a large development at Z Canyon and the Electric Bond & Share Company is planning to harness Kettle Falls. None of these projects will interfere with the eventual irrigation of the Columbia Basin.

New President for Sullivan

At a meeting of the Board of Directors of the Sullivan Machinery Company on Dec. 31 Arthur E. Blackwood, of Chicago, was elected president of the company, succeeding the late Frederick K. Copeland. Mr. Blackwood has been with the Sullivan Machinery Company for the last 32 years. He joined the Sullivan organization shortly after graduating at Toronto University, as a mechanical and electrical engineer, and later became manager of the company's Eastern sales department, with headquarters in New York, which office he held for 23 years. He was then elected a director and first vice-president in charge of finances, and moved to the company's head office at Chicago.

Guadelupe River Projects

Construction of five dams and hydroelectric plants upon the Guadalupe River at points between Seguin and Gonzales, Tex., will be started immediately by the Hunt Development Company. It is reported that the company will expend approximately $3,000,000 in the construction of the dams, plants, transmission lines and other work connected with the project. The proposed plants will generate approximately 16,000 hp.

More Spot * News

DIRTY COLLARS, *ruined works of art, disfigured buildings and coated lungs are some of the results caused by smoke in Chicago. The Mellon institute estimates that an annual total of twenty million dollars of waste can be attributed to coal smoke in that city. This figures out seven dollars a year for every man, woman and child in the city.*

* * *

ANOTHER HYDRO-ELECTRIC PLANT *will be started immediately on the Slave River near Vancouver, British Columbia. The first unit of the plant will be ready for operation by the end of this year, it is stated, and will develop 43,000 hp. The ultimate development will produce 175,000 hp.*

* * *

SO SUCCESSFUL *have the turbine-electric ocean liners proved to be, operating in the intercoastal service, that the Ward Line has ordered two ships of this type for the New York-Cuba service. General Electric turbine-electric drive will give these ships a turn of speed of 20 knots.*

* * *

FOLLOWING THE LEAD, *perhaps, of the federal government, the New York state legislature is considering a bill to investigate public utility propaganda in that commonwealth. It is doubtful, however, if such an investigation could threaten the world's record for voluminous investigations, which is being made at present in Washington.*

* * *

THE PARLIAMENT, *in Ottawa, Canada, is the scene of a brisk fight between private power interests which are contending for the privilege of developing the St. Lawrence River in the vicinity of Montreal. The government's interest arises from the fact that the river is a navigable stream. The public ownership question also enters.*

* * *

STEVENS INSTITUTE OF TECHNOLOGY *has established a museum of mechanical engineering exhibits. The first American steam locomotive, the original Ford car, an Otto and Langen free piston engine, and models of an Ericsson hot-air pumping machine, of early generators, turbines, and aircraft engines, are among the exhibits. Colonel John Stevens, father of the Institute's founder, was an inventor of considerable note, and is well represented in the museum.*

* * *

JORDAN DAM, *latest of the giant hydro developments of the Alabama Power Company, has been turned over to the system's operating department for regular generating service. The ultimate development at the dam is 160,000 hp.*

Coming Conventions

American Boiler Manufacturers Association, mid winter meeting, Cleveland, Ohio, Feb. 5, 1929. A. C. Baker, secretary, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, at Washington, May, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Oil Burner Association, annual convention, Hotel Pennsylvania, New York City, April 9-11, 1929. For information, address the headquarters of the Association at 420 Madison Ave., New York City.

American Society of Heating and Ventilating Engineers, 35th annual meeting, Chicago, Ill., Jan. 28-31, 1929. A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting, Salt Lake City, Utah, July 1-4, 1929. Calvin Rice, secretary, 29 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers, 25th annual convention, Pittsburgh, Pa., June 17-22, 1929. A. A. Stewart, secretary, Pittsburgh Steel Co., Monnessen, Pa.

Engineering Institute of Canada, annual general and professional meeting, at Hamilton, Ont., Feb. 13-15, 1929. R. J. Durley, secretary, 2050 Mansfield St., Montreal, Que.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; Conference headquarters at the Palmer House, Exhibition at the Coliseum; G. E. Pfisterer, secretary 53 West Jackson Blvd., Chicago.

National Marine Engineers Benefit Association. The 54th annual meeting will be held in Washington, D. C., Feb. 11-16, at the Hotel Hamilton.

World Engineering Conference, Tokyo, Japan, October, 1929. All correspondence should be addressed to the Secretary, World Engineering Conference, Nikon, Kogyo Club, Morunouchi, Tokyo.

Obituary

Joseph W. Legg, a member of the meter engineering staff of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., died on Jan. 2, after a short illness. Mr. Legg was noted as the inventor of several devices for measuring electrical potentials and for photographing electrical transients on transmission lines.

Best known among Mr. Legg's inventions is the "osiso," a small portable oscillograph with which important field studies of transmission line conditions can be made. Mr. Legg was a native of Worcester, Mass., where he was graduated from the Worcester Polytechnic Institute as an electrical engineer in 1915, shortly after joining the staff of the Westinghouse company at East Pittsburgh.

Personals

Howard E. Troutman, formerly Chicago sales manager of the Worthington Pump & Machinery Corporation, an ' Frank R. Wheeler, formerly district sales manager of the C. H. Wheeler Manufacturing Company, were recently tendered a farewell luncheon by their numerous friends in the engineering profession.

George B. Anderson, Jr., has become affiliated with the sales department of the New York office of the National Valve & Manufacturing Company, Pittsburgh, Pa.

Ralph Kennison, who has been assistant to the operating engineer of the Central Maine Power Company, will combine some of the duties of this office with that of division engineer for the central, upper and lower northern divisions of the company.

H. A. Barre has been made chief engineer of the Southern California Edison Company, being promoted to this office from the post of executive engineer of the same organization.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.35@$2.40
Kanawha.....	Columbus.....	$1.25@1.45
Smokeless.....	Cincinnati.....	2.25
Smokeless.....	Chicago.....	2.25
S. E. Kentucky...	Chicago.....	1.35@ 1.60
Steam.....	Pittsburgh.....	1.60@ 1.70
Gas Slack.....	Pittsburgh.....	.75@ .90
Big Seam.....	Birmingham....	1.25@ 1.50
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.25
Barley.....	New York.....	1.00@ 1.75

FUEL OIL

New York—Jan. 10, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4¾c. per gal.; 36@40 deg., furnace, tank-car lots, 6½c. per gal.

St. Louis — Jan. 2, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.3709 per bbl. or 42 gal.; 26@28 deg., $1.4209 per bbl.; 28@30 deg., $1.4709 per bbl.; 30@32 deg., $1.5209 per bbl.; 32@36 deg., gas oil, 4.401c. per gal.; 38@40 deg., distillate, 5.355c.

Pittsburgh—Jan. 2, f.o.b. local refinery, 30@34 deg., fuel oil 4.87½c. per gal.; 36@40 deg., 5.12½c. per gal.

Philadelphia—Dec. 29, 13@19 deg., $0.95@$1.02 per bbl. or 42 gal.; 22 deg. plus, $1.47@$1.53 per bbl.; 26@30 deg., $2.00@$2.06 per bbl.

Cincinnati — Jan. 8, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Jan 2, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 65c. per bbl.; 26@30 deg., 72½c. per bbl.; 30@32 deg., 97½c.@$1 per bbl.

Boston—Jan. 7, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.52c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—Dec. 29, f.o.b. local refinery, 26@30 deg., $1.20 per bbl. or 42 gallons.

Business Notes

The International Combustion Engineering Corporation, New York City, announces that its subsidiary, the F. J. Lewis Manufacturing Company, producers of coal tar products since 1887, will henceforth be known as the International Combustion Tar & Chemical Corporation, with offices at 200 Madison Avenue, New York City and at 2500 South Robey Street, Chicago, Ill.

The Magnetic Manufacturing Company, Milwaukee, Wis., announces that, effective Jan. 1, its products will bear the trade name "Stearns" in addition to the former trade name "High Duty." This action was prompted by the need for a more specific identification of its products as compared to the general term "High Duty" used in the past. The new designation is derived from the names of company officers, R. H. Stearns, president and treasurer and R. N. Stearns, secretary.

The Spray Engineering Company and the Spraco Painting Equipment Company were merged on Jan. 1, and will continue both branches of the business under the name of Spraco, Incorporated. The new offices and factory facilities will be located at 114 Central St., Somerville, Mass.

With the Society Sections

A. S. M. E., Anthracite-Lehigh Valley Section. Meeting at Reading, Pa., Jan. 18. Subject: "Burning Anthracite"; speaker not yet announced.

A. S. M. E., Knoxville Regional Meeting, Mar. 21-23, 1929. Technical program and trips to points of interest.

A. S. M. E., Washington, D. C., Section. Meeting, Jan. 17. Subject: "The Holland Tunnel," by H. R. Sewell, B. F. Sturtevant Company. This talk will be given with special reference to the ventilation problems of the tunnel.

A. S. M. E., Oregon Section. Portland, Oregon, Jan. 25. Subject: "Lubrication of Internal Combustion Engines," by Prof. F. C. Bauder, Corvallis, Ore.

American Water Works Association, Kentucky-Tennessee Section. Annual meeting, to be held at Chattanooga, Tenn., Jan. 24-26, 1929.

Engineers' Club of St. Louis. Meeting Feb. 13, 1929. Subject: "Steam Storage and Steam Distribution," by R. A. Longworthy, vice-president and general manager of Ruths Accumulator Company.

TRADE CATALOGS

DISTRIBUTION TRANSFORMERS—L20331-A is a leaflet put out by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The first page contains descriptive text and the three remaining are devoted to illustrations of construction details and methods of shipment.

ARC-WELDING SETS—The General Electric Company, Schenectady, N. Y., in a four-page bulletin GEA-569B describing constant-potential arc-welding sets, includes two tables of shipping weights and dimensions for motor-generator sets and for generator panels. There are also a wiring diagram and several photographs.

LINE CONTACTS—Line contacts for group-operated outdoor switches is the subject of Bulletin GEA-1062 which the General Electric Company, of Schenectady, N. Y., has just issued. Photographs of variations of these switches are shown.

SYNCHRONOUS MOTORS—Synchronous motors of the low speed engine type are discussed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., in a four-page leaflet numbered 20333-A. There are illustrations of rotors, stators, and of six installations where this type of motor has been used.

WATER-TUBE BOILERS—The Bigelow Company, New Haven, Conn., has issued General Pamphlet No. 28, a collection of beautifully illustrated descriptive sheets describing its products and showing many views of boiler installations in power stations and elsewhere. The text covers almost all phases of boiler design and operation.

WATER GAGE—The Yarnall-Waring Company, of Philadelphia, Pa., is distributing a cardboard working model of its "Hi-Lo" Alarm Water Column. The model shows clearly the operation of this device, by which boiler-water level may be kept automatically within the proper range. A descriptive sheet, WC-1801, accompanies the model.

OIL CIRCUIT BREAKERS—A recent release of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., covers in six pages its Type O-33 electrically operated indoor and outdoor oil circuit breakers. The bulletin gives various view of the breaker parts, diagrammatic sketches and descriptive text.

OIL ENGINES—In Bulletin 32K the Anderson Engine and Foundry Company, Anderson, Ind., describes the main parts of its Type K two-stroke-cycle solid-injection oil engine. In addition there is included a table of engine capacities and weights. The engine is of the low-compression type and was largely superseded by the high-compression Type KD engine, but it has been found that a substantial demand for the K engine still exists, and the builders will continue to manufacture it.

WATER TESTING EQUIPMENT—Under this title the National Aluminate Corporation, Chicago, Ill., has published a twenty-page booklet describing apparatus for testing boiler feed water. Illustrations of the equipment are given, and complete instructions for making the tests are included.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Long Beach—City is having plans prepared for the construction of an auditorium including steam heating system, elevators, etc. Estimated cost $1,400,000. J. H. MacDowell, 516 East 42nd St., New York, N. Y., is architect.

Calif., Los Angeles—Auburn Automobile Corp., E. L. Cord, Pres., 5618 Sunset Blvd., awarded contract for a 12 story office building at Wilshire Blvd. and Mariposa Ave. to Cannon Engineering Co., Chapman Bldg. Estimated cost $2,000,000. Steam heating system, elevators, etc. will be installed.

Colo., Maysville—Public Service Co. of Colorado, Denver, appropriated $250,000 for extensions and improvements to hydro-electric plant during 1929.

Colo., Wiley—Wiley Turkey Growers' Association plans the construction of refrigeration and cooling plant.

Ill., Chicago—La Salle Club, 30 North La Salle St., awarded general contract for the construction of a 35 story office, stores and club building at Wells St. and Wacker Dr., to McLennan Construction Co., 307 North Michigan Ave. Estimated cost $3,000,000.

Ill., Evanston—F. W. Cauley, 7325 Clayton St., Chicago, will soon receive bids for an 8 story apartment buliding including mechanical refrigeration plant, elevators, etc. at Davis St. and Hinman Ave. here. Estimated cost $750,000.

Mass., Boston — Edison Electric Illuminating Co., 39 Boylston St., is receiving bids for the construction of a transformer building in Allston District. Private plans.

Mass., Roxbury (Boston P. O.)—Boston Elevated Railway Co., 31 St. James Ave., Boston, awarded contract for the construction of a boiler house, etc., also garage and filling station on Bartlett St. here to J. F. Griffin Co., 250 Stuart St., Boston. Estimated cost $100,000.

Mich., Melvindale — Continental Ice Refrigeration Co., 33 South Clark St., Chicago, Ill., awarded contract for a 2 story, 60 x 345 ft. ice plant on Wabash Ave, here, to Blome Sinek Co., South Clark St., Chicago, Ill. Estimated cost $80,000.

Minn., St. Paul—Lincoln Holding & Development Co., B. Lifson, 407 Loeb Arcade, Minneapolis, awarded contract for a 12 story office building at Fourth and Cedar Sts., to Fleisher Engineering & Construction Co., 410 North Michigan Ave., Chicago, Ill. Estimated cost $1,200,000. Steam heating system, elevators, etc., will be installed.

Minn., St. Paul—Owner, c/o W. Egeland, 1205 Pioneer Bldg., plans the construction of a 12 story office building, including steam heating system, etc., at 4th and Cedar Sts. Estimated cost $1,000,000. C. A. Hausler, 642 Hamm Bldg., is architect.

Mo., St. Louis—Bd. of Public Service, J. Pritchard, Dir., City Hall, awarded contract for the construction of a sub-station for electric street lighting district F. to E. A. Brunson Construction Co., 1976 Railway Exchange Bldg. Estimated cost $30,000.

Mo., St. Louis—H. Mayer, 3617 South Grand Blvd., will build a 10 story apartment building, including steam heating system, etc., at Magnolia and Lawrence Sts. Estimated cost $750,000. Work will be done by owner's forces.

Mo., St. Louis—Sovereign Building & Investment Co., A. H. Stiel, Pres., 815 Chestnut St., will build a 20 story apartment building, including steam heating system, etc., at Lindell St. and Euclid Ave. Estimated cost $2,000,000. N. B. Howard and N. C. Finley, International Life Bldg., are architects. Work will be done by separate contracts.

Neb., Omaha—Nebraska Power Co., Electric Bldg., 15th and Farnam Sts., plans to expend $4,000,000 for extensions and improvements to steam power plant to include new buildings, generators, transformers, transmission lines, etc., here. Electric Bond & Share Co., 1 Rector St., New York, N. Y., is engineer.

N. J., Asbury Park—Monmouth Title Mortgage & Guaranty Co., and Lincoln Mortgage & Title Guaranty Co., 416 Main St. is having competitive sketches made for the construction of a 15 story office building including steam heating system, etc. at South Main St., West Lake Dr. Estimated cost $750,000. P. Freshnan, 50 Court St., Brooklyn, N. Y. is architect.

N. J., Jersey City — Owner, c/o P. Simeone & Co., Inc., 22 Journal Sq., Archts. and Engrs., is having sketches made for the construction of a power house to include 500 hp. boiler, 600 kw. engine, etc. Estimated cost $150,000.

N. J., Maurer—Barber Asphalt Paving Co., is receiving bids for the superstructure of a pump house, flume stack, etc. Estimated cost $40,000. Private plans.

N. J., Sayreville—Eastern New Jersey Power Co., Main St., awarded contract for the construction of an electric generating plant 60,000 kw. capacity to Management & Engineering Corp., 327 La Salle St., Chicago, Ill. Estimated cost $6,000,000.

N. Y., New York—Loews Theatres, 1540 Broadway, is having plans prepared for the construction of two carbon dioxide refrigeration and cooling plants, one at 221 West 83rd St. and one at 567 Lexington Ave. Estimated cost $25,000 each. L. F. Freischman, 1540 Broadway, is architect.

N. Y., New York—New York City Baptist Mission Society, E. L. Ballard, Pres., plans the construction of a 14 story hotel at 168 Second Ave. Estimated cost $1,100,000 E. Roth, 1440 Broadway, is architect.

N. Y., Yonkers — Warburton Building Corp., c/o W. P. Katz, 45 South Broadway, plans the construction of an 8 story apartment building at 556 Warburton Ave. Estimated cost $1,000,000.

O., Cleveland—Cuyahoga Cold Storage Co., L. Malbin, 2704 East 34th St., awarded contract for an 80 x 80 ft. cold storage warehouse to G. Boman, 1679 Coventry Rd. Estimated cost $150,000.

O., Cleveland—Dept. of Public Welfare, J. E. Harper, Dir., Columbus, will soon award contract for the construction of a cold storage plant at State Farm here. H. B. Briggs, Hartman Hotel Bldg., Columbus, is engineer.

O., Cleveland—The Shaker Co., c/o J. J. Arnold, Pres., Terminal Tower, will soon award contract for a 7 story apartment building including steam heating system, etc. at Moreland Circle. Estimated cost $750,000. P. L. Small, Terminal Tower, is architect.

Okla., Enid—Garfield Hotel Co., is having preliminary plans prepared for a 10 story hotel including steam heating system, elevators, etc. on Randolph St. Estimated cost $500,000. Architect not selected.

Okla., Konawa—E. W. Baker & Co., Perrine Bldg., Oklahoma City, is having preliminary plans prepared for the construction of a 10 ton raw water ice plant here. Estimated cost $25,000. Private plans.

Okla., Towkawa—City awarded contract for the construction of a municipal electric light plant to Fairbanks-Morse Co., Beloit, Wis. Estimated cost $150,000.

Pa., Eddystone (br. of Chester)—American Steel Foundries Co., 410 North Michigan Ave., Chicago, Ill., plans the construction of an 8 story office building, power house, etc., here. D. Lofts, Wrigley Bldg., Chicago, Ill., is architect.

Pa., Philadelphia — Corp., c/o M. J. Meyers, 250 Park Ave., Archt., awarded contract for the construction of an 8 story hospital at 10th and Clinton Sts., to Mideast Construction Co., 50 Court St., Brooklyn, N. Y. Esimated cost $1,000,000.

Pa., Pittsburgh—Allegheny General Hospital, H. L. Mason, Oliver Bldg., will receive bid about Apr. 1 for the construction of a 15 story hospital including power plant at North Ave. and Porterfield St. Estimated cost $6,000,00. York & Sawyer, 100 East 42nd St., New York, are architects. C. R. Place, 70 East 45th St., New York, N. Y., is engineer.

Pa., Reading—Corp., c/o W. A. Sharp, 22 North 5th St., will receive bids about Feb. 1 for a 26 story hotel at 5th and Washington Sts. Estimated cost $2,000,000. W. L. Stoddart, 50 East 41st St., New York, N. Y., is architect.

R. I., Pawtucket—Pawtucket Ice Co., H. L. Russell, 126 Main St., will soon receive bids for the construction of an artificial ice plant. R. E. Palmer, 58 Suffolk St., Holyoke, Mass., is architect. York Ice Machinery Corp., 200 Causeway St., Boston, Mass., is engineer.

R. I., Providence—Narragansett Electric Co., Turks Head Bldg., awarded contract for the construction of a power sub-station to New England Power Construction Co., 89 Broad St., Boston, Mass. Estimated cost $600,000.

Tennessee — Holston River Power Co., Rogerville, filed application with State Railroad and Public Utilities Commission for 3 power sites in East Tennessee. Power installation would be 24,000. 30,000 and 20,000 hp. respectively. Est. $15,000,000.

Tenn., Memphis—Kaye Ice Co. awarded contract for the construction of an ice plant at Union Ave. and Southern Ry., to Ferguson Construction Co., Dermon Bldg. Estimated cost $15,000.

Texas—R. L. Hill, Alvarado and B. L. Martin, Itasca, plan the construction of a 25 ton ice plant at McAllen, 20 ton plant at Harlingen and 25 ton plant at Brownsville. Estimated cost $50,000, $45,000 and $60,000 respectively. Private plans.

Tex., Amarillo—City plans waterworks improvements including new wells, pumping plant, pumping equipment, etc. Estimated cost $100,000. H. B. Jones is city engineer. W. Kiersted, 614 Interstate Bldg., Knasas City, Mo., is consulting engineer.

Tex., Levelland—R. L. Lea, plans the construction of an ice plant. Estimated cost $35,000.

Tex., San Antonio — City will receive bids late in January for the construction of a sewage disposal plant including pump house, etc. Estimated cost $1,250,000. Hawley & Freese, Frost Bldg., are engineers.

Tex., Weimar — City plans an election Feb. 5 for waterworks improvements, including pumping unit, mains, etc. Estimated cost $50,000. H. Holt, City Hall, Mayor.

Tex., Wharton—Union Sulphur Co., 33 Rector St., New York, N. Y., have been granted permit from State Bd. of Water Engineers for diverting 30,000 acre ft. of water annually from San Bernard River. Plans include dam and pumping plant for sulphur mining. Estimated cost $100,000. Private plans.

Wash., Seattle — United Exchange Building, Inc., Railway Exchange Bldg., is having plans prepared for the construction of an 18 story office building at First and Second Aves. and Marion St. Estimated cost $3,500,000. J. Graham, Dexter Horton Bldg., is architect and engineer.

Wash., Tacoma — C. F. W. Lundberg, Provident Bldg., Archt., will receive bids about Mar. 1 for a 22 story office building, including heating system, three automatic high speed electric elevators, etc., for Tower Building Co., Provident Bldg. Estimated cost $1,250,000.

Wis., Milwaukee—St. Joseph's Hospital of Franciscan Sisters, 639 4th St., awarded contract for the construction of a group of hospital buildings at Chambers St. and Burleigh Ave., to W. W. Oeflein Inc., 110 East Wisconsin St. Estimated cost $2,000,000. Steam heating and refrigeration systems, elevators, etc., will be installed.

B. C., Bridge River—British Columbia Electric Ry. Co., 425 Carroll St., Vancouver, awarded contract for extensions and improvements to power tunnel to double present size, also to construct 220,000 v. transmission lines to Pacific Engineers, Ltd., 827 Powell St., Vancouver. Estimated cost $1,000,000.

B. C., Ruskin—Brtiish Columbia Electric Ry. Co., 425 Carroll St., Vancouver, plans the construction of a hydro-electric power development on Slave River here, to include dam 183 ft. high and 325 ft. long, 43,000 hp. generator with foundations for another of same size together with auxiliaries, switching station, etc., also 60,000 v. transmission line. Estimated cost $7,250,000. E. Carpenter, 425 Carroll St., Vancouver, is engineer. Bids will be called for immediately.

Ont., Toronto—Henry Falk, 45 Richmond St. W., plans the construction of a 20 story hotel including steam heating system, elevators, etc. at York and Piper Sts. Estimated cost $1,000,000. Baldwin & Greene, 26 Bloor St. W., are architects.

Ont., Toronto—St. Michaels College Board, 50 St. Joseph St., plans the construction of a college building including steam heating system, elevators, etc. on St. Joseph St. Estimated cost $1,000,000. A. W. Holmes, 79 St. Joseph St., is architect.

Ont., Toronto — Toronto Hydro Electric Commission, 225 Yonge St., awarded contract for the construction of an outdoor sub-station at Ossington Ave. to Witchall & Sons, 56 St. Helens Ave. Estimated cost $30,000.

Equipment Wanted

Boilers—Superintendent of Lighthouses, Portland, Me., plans the installation of Scotch or Water tube type boilers in Lighthouse tender "Hibiscus."

Electrical Equipment — Water Commissioners, Town Hall, Goderich, Ont., plans the installation of electrical equipment including transformers, etc., to replace present equipment. Estimated cost $15,000.

Generator — Dept. of Mental Hygiene, Capitol, Albany, N. Y., will receive bids until Jan. 23 for an electric generator for Binghamton State Hospital, Binghamton, N. Y.

Pump and Motor—City of Granger, Tex., S. D. Davis, Mayor, will receive bids until Jan. 22 for one 5 m.g.p.m. centrifugal pump and motor for proposed waterworks improvements. Estimated cost $44,000.

Pumps, etc. — Town of Vankleek Hill, Ont., will soon receive bids for pumps, etc., for proposed waterworks system. Estimated cost $55,000.

Pumps, etc.—City of North Bay, Ont., plans to purchase pumps, etc., for proposed central disposal plant. Esitmated cost $100,000.

Superheater Tubes—Division of Light & Power, Cleveland, O., will receive bids until Jan. 18, furnishing Superheater tubes.

Transformers, Switches, Circuit Breakers, etc.—Toronto Hydro Electric Commission, 225 Yonge St., Toronto, Ont., plans the installation of transformers, switches, circuit breakers, etc., in proposed outdoor sub-station.

Industrial Projects

Calif., Los Angeles—AIRCRAFT FACTORY—Moreland Aircraft Co., 5701 Boyle Ave., awarded contract for a 1 story, 80 x 200 ft. factory at Mines Field to Austin Co. of California, 777 East Washington St.

Calif., Santa Clara—PLANING MILL, etc.—Pacific Manufacturing Co. will build a 385 x 488 ft. planing mill, etc. Estimated cost $250,000. Work will be done by day labor.

Ill., Belleville — STOVE FACTORY — Baker Stove Co., 905 Freeburg Ave., is receiving bids for the construction of a 2 story, 128 x 144 ft. stove factory at Cleveland and Freeburg Aves. Estimated cost $40,000. Gill & Jackson, 520 Buder Bldg., St. Louis, are architects.

Ill., Chicago—MOTOR SHUTTER FACTORY—Pines Winterfront Co., 404 North Sacramento Ave., is having preliminary sketches made for a 2 story factory for the manufacture of winterfronts for automobiles. Estimated cost $1,000,000. Mundie & Jensen, 39 South La Salle St., are architects.

Ind., Valparaiso—FACTORY AND POWER HOUSE—Febric Insulating Co., is reeciving bids for the construction of a 1 story, 112x350 ft. factory and power house. Estimated cost $100,000. Lockhart & Fett, 457 Associates Bldg., are architects. tects.

Me., Lewiston — MOTOR FACTORY—Wade & Dunton Motors Inc., 28 Park St., will build a 4 story, 110x115 ft. factory at Park, Oak and Middle Sts. Estimated cost $100,000. Pulsifer & Eye, Inc., 163 Main St., are architects. Work will be done by separate contracts.

Mich., Detroit — AUTOMOBILE RIM FACTORY—Kelsey Wheel Co. Inc., 6100 McGraw Ave., awarded contract for a 2 story factory to Everett Winters Co., 1651 East Grand Blvd. Estimated cost $50,000. Steam heating, electric motors and equipment for the manufacture of steel rims will be installed.

Mich., Detroit—AUTOMOBILE PARTS FACTORY—Motor Products Corp., 11801 Mack Ave., awarded contract for a 1 and 2 story, 60x200, 100x480 and 60x100 ft. factory to A. A. Albrecht Co., 1117 Penobscot Bldg. Steam heating and miscellaneous metal shop equipment, etc., will be installed.

Mich., Flint — PIPE FACTORY — Crane Co., 836 South Michigan Ave., Chicago, Ill., will soon award contract for a 1 story, 105 x 105 ft. factory here. Estimated cost $50,000. G. Bachman, 218 Pengelly Bldg., is architect.

Mich., Ionia — AUTOMOBILE BODY PLANT—Hayes Ionia Co. awarded contract for the construction of a 1 and 3 story automobile body plant, to Owen Ames Kimball Co., 38 Pearl St., Grand Rapids. Estimated cost $180,000. Steam heating, electric elevators and assembly conveyor and metal stamping equipment will be installed.

Mich., Lansing — AUTOMOBILE CUSHION FACTORY—Burton Dixie Corp., 2207 Willow St., is receiving bids for a 1 story, 173 x 200 ft. factory. Estimated cost $150,000. Private plans. Steam heating, electric motors and machinery and equipment for the manufacture of automobile cushions will be required.

N. Y., Brooklyn — LEAD FACTORY — National Lead Co., E. J. Carnish, Pres., 111 Broadway, New York, N. Y., will soon award contract for the construction of a factory at Marshall and Gold Sts., here. W. Higginson, 101 Park Ave., New York, is architect.

Tenn., Memphis—AUTOMOBILE BODY PLANT—Murray Corp. of America, Clay Ave., Detroit. Mich., is having plans prepared for a 1 story, 575 x 640 ft. automobile body plant here. Estimated cost $2,000,000. A. Kahn, Inc., 1000 Marquette Bldg., Detroit, Mich., is architect.

Ont., Toronto — PAPER FACTORY — Commercial Papers Ltd., W. B. Hanna, 371 Adelaide St. W., plans the construction of a paper factory at 314 King St. Estimated cost $50,000. Architect and engineer not selected.

Ont., Toronto — STEEL FABRICATING SHOP—Toronto Iron Works, ft. of Cherry St., plans the construction of a 1 story steel fabricating shop. Estimated cost $500,000.